

**NEYVELI LIGNITE CORPORATION LIMITED
(NLC LTD)**

**NEYVELI NEW THERMAL POWER PROJECT
2x500 MW LIGNITE FIRED UNITS AT NEYVELI
(TG PACKAGE)**

**PROJECT SPECIFIC
TECHNICAL SPECIFICATION FOR
SINGLE GIRDER EOT CRANE**

SPECIFICATION NO.: PE-TS-402-524-A001



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA**

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TECHNICAL SPECIFICATION FOR
SINGLE GIRDER CRANE
2X500 MW NNTPS (TG)

SPECIFICATION NO. PE-TS-402-524-A001

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SCOPE OF ENQUIRY

- 1.1 The specification is intended to cover design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at FOR site including erection & commissioning spares, maintenance tools & tackles, all accessories (isolating switch and power cable from isolating switch to DSL rails) including freight in line with drawings/ documents/ test procedures approved by BHEL/ Customer for SINGLE GIRDER CRANE.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the responsibility of providing such facilities to complete the supply, erection and commissioning of the cranes and its accessories.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context.

SECTION B

PROJECT INFORMATION

A handwritten signature in black ink, appearing to be 'B. ...', with a horizontal line underneath.



SECTION - 2

2 GENERAL PROJECT INFORMATION

2.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

2.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-1 Expansion and TPS-II.

2.3 Project & Site Information

- | | | | |
|---------|---------------------------------|---|--|
| (i). | Owner/Purchaser | : | Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India |
| (ii). | Consultant | : | Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India. |
| (iii). | Project Title | : | 2x500 MW Neyveli New Thermal Power Station (NNTPS) |
| (iv). | Location | : | 200 kms south of Chennai and 50 kms south-west of Cuddalore |
| (v). | Latitude | : | 11° 34' 00" N to 11° 35' 00" N |
| (vi). | Longitude | : | 79° 26' 00" E to 79° 27' 00" E |
| (vii). | Elevation above MSL | : | +67 m |
| (viii). | Nearest Railway Station | : | Neyveli, |
| (ix). | Nearest Sea Port | : | Chennai, at a distance of 200 km |
| (x). | Nearest Airport | : | Chennai, at a distance of 200 km |
| (xi). | Road Access/Approach to Site | : | Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore – Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads. The approach road is approximately 15 kms from Chennai–Thanjavur NH – 45C road |
| (xii). | Site Meteorological Data | | |
| | • Max ambient temperature | : | 42.8° C |

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LII-GEOE11019-G-00156-002	02	TG, Vol-IA, IFB–NTA2	- 9-	25-Jun-1

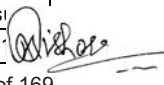


- Min Ambient Temperature : 26.9° C
 - Wet bulb temp : 29° C
 - Max. Relative Humidity : 92 % in the month of September
 - Min. Relative Humidity : 23 % in the month of May
 - Rainfall : About 1265.7 mm annually (average)
 - Wind direction : South West to North East direction
 - Wind Speed : 97.2 km/hr (maximum recorded)
4.3 km/hr (average wind speed)
 - Seismicity : As per IS: 1893 (part 4) (Zone-II)
Importance factor: 1.75.
- (xiii). Languages spoken in the : English, Tamil
region

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SPECIFIC TECHNICAL REQUIREMENTS

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1.0.0 SCOPE OF WORK**1.1.0 SUPPLIES**

1.1.1 Equipment and services to be furnished by the bidder for the Single Girder EOT with accessories as per the details given in data sheet A. Any equipment / accessories not specified in the specification but required to make the crane units complete and efficient shall also be under the bidder's scope of work. Each EOT crane shall include all necessary items but shall not be limited to the following: -

1. Bridge girder.
2. End carriages complete with wheels
3. Electric Hoist
4. CT / L T drive arrangement
5. Electrical equipments
6. PVC Shrouded Conductor Bus Bar Type DSL with accessories for entire bay length
7. Rail (for O/H crane only)
8. Earthing arrangement.
9. Painting of crane.
10. First fill of lubricant.
11. O & M Manual, drawings and documents.
12. Main isolating switch and power cable from 1.5M above ground / operating floor to down shop lead.

1.1.2 Maintenance Tools and Tackles

A complete unused new set of tools & tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped, so as it can be easily identified for use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and specially protected against rusting in tropical climate and minimum the following shall be provided.

S. No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Min. 6 nos. Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6.	Grease Gun	1 No.
7.	Oil Gun	1 No.
8.	Hand Lamp	1 No.
9	Line tester	1 No.

Note: All maintenance tools & tackles are to be supplied in a tool box.

1.1.3 Erection and commissioning spares. (for details refer price format)

1.1.4 Mandatory Spares -



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1.2.0 Services to be provided by the bidder

- 1.2.1. Packing, forwarding and transportation to site.
- 1.2.2. Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by customer.

1.3.0. Inspection and Testing**1.3.1. Inspection and testing at Manufacturer's works****A. Shop inspection and tests will include but not limited to the following - (In-process)**

- i. Identification, co-relation and verification of material test certificates for the important components like girders, major load carrying components, hooks, gears, shafts, wheels, wire rope drum, wire rope, gear box etc. For other components supporting test certificates or random check tests shall be conducted / furnished.
- ii. Qualification of welder and welding procedure as per ASME section IX .
- iii. 100% radiography of tension zone & 25% radiography of compression zone on butt welds of load bearing members shall be carried out with acceptance norms as per ASME Sec VIII Div.1 UW 51. DP test of all butt welds shall be carried out as per ASTM E 165/ ASTM E 109 with acceptance norms as per ASME Sec VIII Div.1
- iv. For fillet welds visual inspection on all welds. Die- penetration test (DPT) for fillet welds in the load bearing members as per ASME-165/ASTME 109 and acceptance norm as per ASME section VIII Div. 1.
- v. Ultrasonic test on forgings and casting of critical components like hook, shafts, axles, gears, wheels, pulleys, etc. Ultrasonic test for casting as per ASME Section III NB 2572 & for forging as per ASTM A388.

Unacceptable defects in forgings are as given below: -

1. Cracks, flaws, seams and laps.
2. Defects giving indication larger than 4mm diameter equivalent flaw.
3. Groups of defects with maximum indication less than that from a 4mm dia, equivalent flaw, which cannot be separated at testing sensitivity if the back echo is reduced by 50%.
4. Defects giving indication of 2 to 4 mm diameter equivalent flaw separated by a distance less than 4 the size of the larger of the adjacent flaws.
- vi. PT/MT on component with surface hardening as per ASTM E -165 and ASTM E 138 respectively with no surface defects.
- vii. Gearbox trial run test as per AGMA standards.
- viii. Acceptance and routine tests (HV and insulation) for all electrical and electromechanical components and system as per governing specification
- ix. Functional and simulated operation test, sequencing, interlocks, safety, protection and alarm system. Test on CRANE / CRAB motors and other mechanical, electrical, electro-mechanical as per BHEL technical specification and or as per applicable code



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- x. Cranes shall be completely assembled at manufacturers' works to check the misalignment of gears, shafts and other items. Gear box shall have the idle run for minimum two (2) hours.

B. Testing At Works (Final)

- i. Deflection test of bridge girder at rated load.
- ii. No load / load (SWL) / Over load test (running of CT & Hoisting mechanism at 125% of rated load.)
- iii. Electrical tests for brakes, panel, electrical equipment etc as per IS - 3177
- iv. Measurement of speed of CT & Hoisting (lowering & raising) at rated load.
- v. All Other tests as per IS-3177.

Note: Refer Annexure-III, Section-C, Volume II-B for "Shop test Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works."

1.3.2 Testing at site

The following tests shall be carried out at site by **BHEL** as a part of Erection and Commissioning:

- a) All the tests as mentioned against S.N. 1.3.1 (B) above, with actual hook and wire rope.
- b) Speed test at rated load for hoisting / CT and LT mechanism.
- c) Brake test and working of electric hoist.
- d) Any other test as per IS-3177-1999.

The successful bidder shall furnish their recommended procedure for carrying out the Erection, Commissioning & testing at site as mentioned above.

1.4.0 SURFACE PREPARATION, PAINTING & COLOUR SCHEME

Detailed painting procedure has been attached as Annexure IV , Section C, Volume IIB. Bidder shall follow the same.

1.5.0. Drawing / design document for submission after award of contract

Drawing/ design documents to be submitted as per list & submission schedule attached as Annexure-V. Any other design document/ drawing as required by customer/ BHEL shall be submitted by bidder during detail engineering without any implication.

2.0.0. Works Excluded

2.1.0 Supply of steel gantry girders/ ISMB for crane travel

2.2.0 For EOT crane:

The purchaser shall provide single point 415V, 3 phase, 4 wire and 50Hz power feeder at any point of the bay or in the middle of the bay as specified in the Data sheet A. Vendor shall provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL. Any other supply required by the bidder shall be arranged by the bidder himself by using suitable transformer as per the specification.

3.0.0. Deviations

If the proposal submitted has got any deviation from the technical stipulations in the tender document bidder shall tabulate the same in the appropriate "Schedule of Deviations" furnishing full par



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such deviations. Deviations are to be furnished with mention to specific clause number. Reasons / explanations for such deviations shall be furnished .Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall indicate 'NO DEVIATION' in the deviation schedule.

4.0.0. Make of Sub - Vendor items

Make of bought out items will be as per Annexure-I, section C, volume II-B of the specification. No other make will be acceptable, until and unless specifically got approved by BHEL/Customer during detail engineering. Acceptance/non acceptance of same shall not have any impact on manufacturing & delivery schedule and on cost of crane.

5.0.0 INFORMATION TO BE FURNISHED BY BIDDER ALONG WITH THE OFFER

As detailed in Annexure VI, Vol III

6.0.0 OTHER REQUIREMENTS

Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



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ANNEXURE-I
MAKES OF SUB VENDORS ITEMS

S.N.	ITEM	MAKES
1.0	STEEL	SAIL/TISCO/ JINDAL
2.0	HOOKS	KARACHIWALA/ SMRITI FORGING / Steel Forging & Engg. Co., Kolkata
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN/ Bharat wire rope/FORT WILLIAMS
5.0	BEARINGS	SKF/ FAG/ TATA/ NBC
6.0	MOTORS	SIEMENS/NGEF/CROMPTON-Ahmednagar /KIRLOSKAR-Hubli, Bangalore / BHARAT BIJLI-Mumbai / ALSTHOM / ABB-Faridabad
7.0	BRAKES	ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE/PETHE/BCH
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ GEIL/ L&T
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ TELEMECHANIQUE
14.0	TRANSFORMERS	INDCOIL / LOGICSTAT / PRAGATI / PRAYOG KAPPA / SOTHERN ELECTRIC / AUTOMATIC ELECTRIC / PRECISE ELECTRICALS / SILKAAN
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON (Except electric ballast)
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS / UML ENGINEERING
18.0	LIGHTING SWITCHES	ANCHOR / ELLORA
19.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
c)	FLEXIBLE TRAILING CABLES	NICCO / UNIVERSAL / POLYCAB / KEI
20.0	Cable gland	COMMET / SUNIL&CO. / ARUP ENGINEERING
21.0	PUSH BUTTONS	SIEMENS / L&T / BCH
22.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG
24	SAFETY SWITCHES	ALSTHOM / L&T / SIEMENS
25	PENDENT PUSH BUTTON STATION	OEM
26	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD
27	MCB	MDS / INDO COPP / STANDARD
28	PANELS	OEM
31	INSULATORS & COPPER CONDUCTORS	BHEL APPROVED MAKE
32	CASTINGS	KOLHAPUR STEEL / GNAT FOUNDRY / KIRTI ALLOYS
34	VVVF DRIVE	YASKAWA (L&T)/ ABB / SIEMENS / SCHNIEDER
35	SHROUDED DSL	SUSHEEL / STROMAG

NOTE :- Bidder to note that the list of sub-vendor shall be adhered to, any addition/ deletion of sub-vendor by Customer during detail engineering will not call for any Commercial implication.



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ANNEXURE III

Procedure for Load/Overload testing of Single Girder EOT/HOT crane at Manufacturer's Works

Objective: To demonstrate final NO load, Load, Overload, Deflection & Functional tests of assembled Crane for the purpose of acceptance in line with IS 3177.

Basic Assumptions / Inputs for testing at Works:

- Actual job hook shall be used for load, overload tests for hoisting.
- Actual wire ropes shall be used for load, overload testing.
- Shop cables can be used for temporary power supply for the purpose of showing various functional tests at shop.
- Interlock and limit switch operation check will be shown for hoisting and CT motion.

Procedure for Load / Overload testing:

- The cranes shall be tested for no load and load /overload test at works generally in conformance with the IS – 3177 (1999). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.
- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.
- For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ground.
- Creep speed motions shall be checked over a distance of about 500 mm.



ANNEXURE- IV

PAINTING SCHEME



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17.1 General

17.1.1 This specification covers the materials, tools, facilities and quality requirement for surface preparation and painting of steel structures, mechanical & electrical equipments, technological structures, piping, ducts, chutes etc. for 2 X 500 MW Thermal Power Plant as elaborated in the further text.

This specification will be read in conjunction with other parts/ volumes of the Tender specification where other related project requirements have been indicated.

The term "Painting" referred herein covers rust preventive, preventive and decorative coating along with surface preparation of the following areas.

- a) All Mechanical equipment, Technological structures, chutes, piping, ducts etc. unless otherwise specifically indicated in the relevant section
- b) Various types of static and rotary equipment inclusive of electric motors etc. +
- c) Steel tanks and vessels
- d) Pipe work including trestles, supports, hangers, etc.
- e) Metallic duct work such as ventilation ducts, gas ducts including supports, hangers, etc.

This is a general guideline to the painting scheme to be followed. However, in case if a specific painting procedure is stipulated in any tendering specification, then this general guideline will be superseded. Any special case which may arise from time to time will be dealt with individually on the merits of each case.

17.1.2 Surfaces made of aluminium, brass, bronze, stainless steel, and other corrosion resistant alloys are not required to be painted unless specified except for identification bands or for aesthetic purposes.

17.1.3 All machined mating surfaces (e.g. flanges) will be properly cleaned, and will be provided with protective coating before despatch.

17.1.4 The complete painting scheme for any item includes the following basic activities:

- i) Proper surface preparation
- ii) Application of primer coats
- iii) Application of intermediate coats and
- iv) Application of finish coats

All the above coats will be of quality paint products and of approved make as stipulated in this specification. The scope of work will also include supply of all paint materials as per specification described herein and of approved quality/ specifications.

17.2 Painting For Mechanical & Electrical And Other Equipment, Mechanical Structures, Piping, Ducts Etc.



17.2.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

17.2.2 Codes and Standards

Painting of equipment will be carried out as per the specifications indicated below and will conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303:		Glossary of terms relating to paints
IS:2379:		Colour code for identification of pipelines
IS:1477:		Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524:		Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395:		Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338:		Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278 :		Code of practice for white washing and colour washing
IS:3140:		Code of practice for painting asbestos cement building products
IS:158 :		Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting
IS : 2074:		Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS : 104:		Ready mixed paint, brushing, Zinc Chrome, priming
IS : 2932:		Enamel , synthetic, exterior (a) undercoating (b) finishing specification.

17.2.3 Preparation of Surfaces

- a) Surface preparation being a pre requisite for any paint application, will be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrates.
- b) All surfaces to be painted will be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes will be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents will be resorted to only in such areas where other methods specified above have not achieved the desired results.



Cleaning with solvents will be adopted only after written approval of the Purchaser/ consultant.

- c) The workmanship will, in general, be in accordance with IS: 1477-1971. Surface of all the steel works to be painted will be thoroughly cleaned and degreased in accordance with IS:1477(Part-I) by means of mechanical and power tool cleaning or shot blasting. The cleaning quality will conform to second quality blast cleaning as per BS-4332 or to SA 2.5 of Swedish Standards Institution SIS 055900. Cleaning of surface will ensure primer coat is rigidly anchored to the virgin metal surface. Primer paint will be applied not later than 2-3 hours after preparation of surface, unless otherwise specified.

17.2.4 The acceptable surface preparation quality/grade are described under each painting scheme. The procedures covered are solvent cleaning, hand tool cleaning, power tool cleaning and blast cleaning

a) **Solvent cleaning (SP 1) (If applicable)**

The surface will be cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning will not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning will be followed by other cleaning procedures as stated below.

b) **Hand tool cleaning (SP 2)**

The surface will be cleaned by vigorous wire brushing done manually to St-2 quality. This method effectively removes loosely adherent materials, but would not affect residues of rust or mill scales that are intact and firmly adherent.

c) **Power tool cleaning (SP 3)**

The surface will be cleaned by electric or pneumatic tools to St-3 quality. The tools will be used carefully to prevent excessive roughing of surface and formation of ridges and burns. This method will remove loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent.

d) **Blast cleaning (SP 4)**

The surface will be cleaned by impingement of abrasive materials, such as graded sand at high velocity created by clean and dry compressed air blast. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning and excessive surface scales are



removed by hand tools or power tool cleaning. The surface will be cleaned to Sa-2 1/2 quality which means that to 95% of surface area is free from all rust, mill scales and visible residues, foreign materials, etc. The blast cleaning is not recommended for sheet metal work.

17.2.5 Primer Paints (P)

After the surface is prepared in a manner acceptable to purchaser/ consultant, two (2) coats of Primer paints will be applied only on dry and clean surfaces. Second coat of red oxide primer will be applied only after first coat has dried up completely. Coating of primer will in general conform to IS:2074-92 and will be applied by brushing to ensure a continuous film without “holidays”.

a) Primer paint P1: (Epoxy based)

A two pack air drying epoxy polyamide resin based red oxide –zinc phosphate (primer):

Epoxy content (% wt)	15 to 18
Air drying time	About 30 minutes (touch dry) Over night (hard dry)
Dry film thickness (DFT/coat)	30 microns (min)
Temperature resistance	Upto 120 deg.C dry heat

b) Primer paint P2 (Epoxy based)

A two pack air drying epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

Epoxy content (% wt)	8 to 10
Air drying time	About 10 minutes (touch dry) 2 hours (hard dry)
Dry film thickness (DFT/coat)	40 microns (min)
Temperature resistance	Upto 300 deg.C dry heat

c) Primer paint P3 (Ethyl zinc silicate, EZS, based)

A two pack heavy duty zinc dust rich silicate primer:



Total solids (% wt)	84 $\pm$ 2
Air drying time	16 hours
Density	3.07 $\pm$ 0.005
Dry film thickness (DFT/coat)	60 microns (min)
Temperature resistance	Upto 450 deg.C dry heat

17.2.6 Intermediate paints (N)

These paints will be applied over primer coats as an intermediate layer to provide weatherproof seal of primer coats.

a) Intermediate paint N1

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time	6 to 8 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	80 microns
Temperature resistance	Upto 180 deg.C dry heat
Compatible with	Primer P1

17.2.7 Finish Paint (F)

Finish paint coats will be applied over primer coats and intermediate coats after proper cleaning and touch up of primed coats. Synthetic enamel paint comprising of IS:2932-95 will be used for finish coats.

a) Finish paint (F1)

A two pack air drying epoxy polyamide enamel suitably pigmented.

Air drying time	2 to 3 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	30 microns
Temperature resistance	Upto 130 deg.C dry heat



Compatible with	Primers P1 and P2 Intermediate N1
Colour	Generally all shades

b) Finish paint (F2)

A single pack synthetic rubber based enamel paint.

Air drying time	2 hours (touch dry) 24 hours (hand dry)
Dry film thickness (DFT/coat)	25 microns
Temperature resistance	Upto 200 deg.C dry heat
Compatible with	No primers
Colour	Generally all shades

c) Finish Paint F3

A single pack heat resistant silicon Aluminum paint.

Air drying time	3 to 4 hours (touch dry) 24 hours (hard dry)
Dry film thickness (DFT/coat)	25 microns (min)
Temperature resistance	upto 400 deg.C dry heat
Compatible with	Primer paint P3
Colour	smooth aluminium

Heat resistant Silicone Aluminium Paint with suitable air drying time as per IS 13183 Gr I, 25 microns per coat.

- d) After cleaning the dust on the dried up primer/ intermediate paint, first coat of synthetic enamel will be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint



will be applied only after gently removing the gloss of first coat from entire surface and it is dusted off the surface. The requirement of workmanship will be as per IS:1477-71.

- e) Equipment No. and the name of the equipment will be painted on the surface of the equipment on visible locations in English. Service of the Pipe/Line designation with arrow identification for the direction of flow will be painted on all pipes at visible locations at an interval of 20 metres. Wherever pipelines are insulated, the service of the piping and arrow mark will be painted over the clad surface.
- f) For painting of structure, equipment, tanks & vessels etc. suggested colour code is given in clause 17.2.8. For items not specified, the colour code to be followed for piping will be in line with IS 9404:2002 (Identification of pipelines used in Thermal Power Plants – Colour Code).
- g) For insulated pipeline the finish paint will be applied at that place where colour band is to be painted on the aluminium sheeting. The finished paint (colour band) will be of 1m length at that place.
- h) Colour band for piping will be applied at these following locations-
 - At start and end point.
 - At every 10m intervals.
 - At every T joints and cross connection of piping.
 - At every battery limit of pipeline
 - Near valves before connection with the consumer.
- i) Width of band

Size of pipe including insulated Pipe line outside diameter	Width of band
80 mm and below	25 mm
Above 80 mm upto 150 mm	50 mm
Above 200 mm upto 300 mm	75mm
Above 350 mm	100 mm



- j) Direction of flow will be indicated by black or white arrow in contrast to the base colour on the pipeline. Length of the arrow will be minimum 125 mm and width will be minimum 65 mm. These will be put at an interval of 10 m.

17.2.8 Suggested Colour Codes For Painting of Structures, equipments, tanks & vessels etc.

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLUR (BAND	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark admiralty grey	632	-	-
2.	Fans, pumps, motors, compressors.	Light grey	631	-	-
3.	Outdoor ,Stand pipes, vent pipes	Aluminium	-	-	-
4.	Indoor Tanks	Aluminium	-	-	-
5.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
6.	Tanks (without insulation and cladding)	Aluminium			
7.	Switchgear	Light grey	631	-	-
8.	MCC/ PDB, Control, relay panels, Bus duct	Light grey	631/7078 of IS:1650	-	-



9.	Transformers	Dark admiralty grey	632	-	-
10.	Machinery guards	Signal red	537	-	-
11.	Turbine	Golden Yellow	356		
12.	Generator & exciter	Light grey	631		
13.	Piping (without insulation and cladding)				
14	Feed water	Sea green	217	Light brown	410
15	Condensate	Sea green	217	Light brown	410
16	D M Water	Sea Green	217	Light orange	557
17	Soft water	Sea green	217	French blue	166
18	Bearing cooling water	Sea green	217	French blue	166
19	Potable & filtered water	Sea green	217	French blue	166
20	Service & clarified water	Sea green	217	French blue	166
21	Condenser and Auxiliary Cooling water	Sea green	217	French blue	166
22	Service air	Sky Blue	101	-	-
23	Instrument air	blue	101	White	-
24	Lubricating oil	Light brown	410	Light grey	631
25	Control oil	Light brown	410	Light	557



				orange	
26	Transformer oil	Light brown	410	Light orange	557
27	Hydrogen	Canary yellow	309	Post office red	538
28	Carbon dioxide	Canary yellow	309	Light grey	631
29	Vacuum pipes	Sky blue	101	Black	-
30	Drainage	Black	-	-	-
31	Stand pipes and all Vent pipes	Aluminium	-	-	-

Notes:

Where band colour is specified, same will be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

17.2.9 Paint Application

- a) Paint will be applied in accordance with manufacturer's recommendations. The work will generally follow IS 1477 (Part II) for jobs carried out in India and SSPC-PA-I or DIN 55928 or equivalent for jobs carried out outside India. Touch up paint to be applied to cover scratches after erection and assembly of equipment at site.
- b) Paint will not be applied when the ambient temperature is 5 deg. C and below. Also paint will not be applied in rain, wind, fog or at relative humidity of 80% and above.
- c) Each coat of paint will be continuous, free of pores and of even film thickness without thin spots. The first coat of finish paint at site will be applied preferably within three months of the shop paint.
- d) Each coat of paint will be dry sufficiently before application of next coat.
- e) Surface which cannot be painted but require protection will be given a coat of rust inhibitive grease according to IS:958-75 or solvent deposited compound according to IS:1153-75 or IS:1674-60.



- f) Surface which will be inaccessible after assembly will receive minimum coats of specified primer. Surfaced to be in contact with wood, brick or other masonry will be given one shop coat of the specified primer.
- g) Parts of steel structure to be embedded in concrete will be given a protective coat of Portland cement slurry immediately after fabrication and thoroughly cleaning the surfaces from grease, rust, mill scales etc. No paint will be applied on this part.
- h) The Contractor will furnish paint manufacturer's test report or technical data sheet pertaining to the paint selected. The data sheet will indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading rate, flash points, methods of application quality of surface preparation required, corrosion resistance properties and colour.
- i) Rust preventive coating will be given to HSFG bolt and nut threads.
- j) Machined surfaces / weld edges will be applied with a coating of temporary rust preventive oil.
- k) All threaded and other surfaces of foundation bolts and its materials, insulation pins, anchor channels, sleeves will be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating will be removed using organic solvents.
- l) The temporary rust preventive coating that already been applied on any components, tubes, pipes etc., will be removed by suitable solvents/ heating to 350-400 Deg.C for an hour before primer paint application-but, in case, it will be ensured that the minimum surface cleanliness required for primer paint application will be Sp2 (equivalent to hand tool cleaning).
- m) All weld edge preparation for site welding will be applied with one coat of weldable primer.
- n) For internal protection of pipes/tubes, VCI pellets will be used at both ends after sponge testing and ends capped. VCI pellets will not be used for SS components and composite assemblies.
- o) Wherever inside surfaces of ducts need protection till erection, two coats of red oxide zinc phosphate primer (P1) paint to IS 12744 to a DFT of 60 microns will be applied after power tool cleaning.

17.2.10 Painting scheme

- a) For a complete painting scheme of any item being painted, all types of paints are to be procured from the same manufacturer as approved by the purchaser.
- b) The painting scheme to be followed for various mechanical/ electrical equipment / structures is briefly given below for guidance to the Contractor.





Legend

SP	Surface preparation quality
P	Primer Paint
2P1 stands for	Two (2) coats of primer paint type P1
N	Intermediate paint
1N 1	One (1) coat of intermediate paint type 1
F	Final Paint
2F1 stands for	Two (2) coats of finish paint type F1
DFT	Dry film thickness
CRT	Clean and retouch
Sa - 2.5	Quality of surface cleaning (i.e. 95 % of the surface area is free from all rust, mill scales and visible residues, foreign materials etc.

c) Painting Scheme

Sl no.	Description	Surface Preparation	Painting Scheme		Total DFT in micron
			At shop	At site	
1.	Steel Structure	Sa 2½	2P1 + 1N1	2F1	200
2.	Mechanical equipment (temp. not over 80 deg. C) Both static and rotary equipment	Sa 2½	2P1 + 1 N1	2F1	200
3.	Equipment with hot surfaces (temp. upto 400	Sa 2½	2P2	2F2	130



	deg. C)				
4.	Equipment with hot surfaces (temp. above 400 deg.C)	Sa 2 ½	2P3	2F3	170
5.	Non insulated pipe/ duct works - Temperature not over 80 °C - Temperature upto 200 °C - Temperature upto 400 °C	Sa 2 ½	2P1 + 1N1 2P2 2P3	2F1 2F2 2F3	200 50 170
6.	Insulated pipe/duct works	St3	2 coats of Alkyd Red Oxide Zinc Phosphate primer to IS 12744 – DFT 30μ/ coat	Not required	60
7.	Condensate piping, ACW, DMCW, service water, potable water and minor structures etc.	Hand tool/ Power tool cleaning to SSPC-SP2	2 coats of HB Chlorinated rubber based red oxide zinc phosphate primer each 50μ	2 coats of Chlorinated rubber based finish paint each	160



				30μ	
--	--	--	--	-----	--

PAINTING SCHEME (METALLIC STRUCTURAL WORKS)				
SURFACES TO BE PAINTED	SURFACE PREPARA TION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM - AT SHOP	FINISHIN G AT SITE
1) CARPENTRY ANCHOR PLATES AND PIPELINE SUPPORT				
- OUTSIDE	SA 2.5	2P1	1N1	2F1
- INSIDE	SA 2.5	2P1	1N1	2F1
2) BRIDGE CRANE				
- STRUCTURE FOR BEAMS	SA 2.5	P1 + P1(S)	1N1 (S)	2F1
- TROLLEY	SA 2.5	2P1	1N1	2F1
3) HOISTS AND MONORAILS				
- MONORAILS	SA 2.5	2P1	1N1	2F1
- HOISTS	SA 2.5	2P1	1N1	2F1

PAINTING SCHEME (THERMAL CYCLE)
--



SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM. AT SHOP	FINISHING AT SITE
1) INSULATED PIPE LINE AND VALVES				
STEAM	SA 2.5	2P1/2P2/2P3	--	--
FEEDWATER	SA 2.5	2P1/2P2/2P3	--	--
DEAERATOR AND FEED TANK				
FEED TANK - INSIDE - <u>OUTSIDE</u>	<u>SA 2.5</u> <u>SA 2.5</u>	<u>Temporary rust preventive paint</u> <u>2P3 or 2 coats of Heat resistant aluminium paint.</u>		
DEAERATOR - <u>OUTSIDE</u>	<u>SA 2.5</u>	<u>2P2 or 2 coats of Heat resistant aluminium paint.</u>		
3) HEAT EXCHANGER				
- INSIDE	SA 2.5	--	--	--
- OUTSIDE	SA 2.5	2P1	1N1	--
4) HEATER				



PAINTING SCHEME (THERMAL CYCLE)				
SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERM. AT SHOP	FINISHING AT SITE
- INSIDE	SA 2.5	--	--	--
- OUTSIDE	SA 2.5	Heat resistant Aluminum paint	--	--
5) PUMPS	SA 2.5	2P1/2P2	1N1	2F1/2F2
6) VENT				
7) NON INSULATED PIPELINE AND VALVES	SA 2.5	2P1/2P2/ 2P3	--	2F1/2F2/2F3
8) DRAINS, PIPELINE AND VALVES TRAPS ETC				
- INSULATED	SA 2.5	2P1/2P2/ 2P3	--	--
- NON INSULATED	SA 2.5	2P1/2P2/ 2P3	--	2F2
8) TANKS				
- OUTSIDE	SA 2.5	2P1/2P2	--	--
- INSIDE	--	--	--	--



PAINTING SCHEME (OIL + GAS-OIL CYCLE)				
SURFACES TO BE PAINTED	SURFACE PREPARATI ON	PAINTING SCHEME		
		PRIME R AT SHOP	INTERM. AT SHOP	FINIS HING AT SITE
1) CLEAN / DIRTY OIL TANK				
- INSIDE	SA 2.5	2P4	--	--
- OUTSIDE	SA 2.5	2P1	1N1	2F1
2) PIPE LINE AND VALVES				
- OUTSIDE	SA 2.5	2P1/2P 2	1N1	2F1/2 F2
- INSIDE	--	--	--	--
3) PUMPS				
- PUMPS	SA 2.5	2P1	1N1	2F1
4) FILTERS				
- OUTSIDE	SA 2.5	2P1/2P 1	1N1	2F1/2 F2
- INSIDE	--	--	--	--



PAINTING SCHEME (CIRCULATING WATER AND SERVICE WATER)				
SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERMEDIATE AT SHOP	FINISHING AT SITE
1) CONDENSER				
- INSIDE	SA 2.5	--	--	--
- OUTSIDE	SA 2.5	2P1	1N1	2F1
- WATER BOX AND TUBE SHEET	SA 2.5	As per specification Volume IIA		
2) PUMPS	SA 2.5	2P1	1N1	2F1
3) PIPELINE AND VALVES				
- INSIDE	SA 2.5	--	--	--
- OUTSIDE (OVER GROUND)	SA 2.5	2P1	1N1	2F1

PAINTING SCHEME (DEMINERALISED WATER)
--



SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERMEDIATE AT SHOP	FINISHING AT SITE
1) PIPELINE AND VALVES - INSIDE - OUTSIDE	-- SA 2.5	-- 2P1	-- 1N1	-- 2F1
2) PUMPS - PUMPS	SA2.5	2P1	1N1	2F1

PAINTING SCHEME (AIR CYCLE)				
SURFACES TO BE PAINTED	SURFACE PREPARATION	PAINTING SCHEME		
		PRIMER AT SHOP	INTERMEDIATE AT SHOP	FINISHING AT SITE
1) PIPE LINE AND VALVES (SA) - OUTSIDE - INSIDE	SA 2.5 --	2P1 --	1N1 --	2F1 --
2) FILTERS / STRAINERS - OUTSIDE	SA 2.5	2P1	1N1	2F1



PAINTING SCHEME (AIR CYCLE)				
SURFACES TO BE PAINTED	SURFACE PREPARATI ON	PAINTING SCHEME		
		PRIME R AT SHOP	INTERM . AT SHOP	FINISHI NG AT SITE
- INSIDE	--	--	--	--

Note : For Piping, Supports, Hangers, CLH, VLH & Other piping system components/ items Painting Scheme as indicated in following table is also acceptable.



Sl No.	Description	Surface Preparation & Surface Profile	Primer Coat		Finish Coat			
			Primer Coat	No of coats & DFT	Paint	No of coat s & DFT	Shade	Total DFT Micro ns (Min.)
1	Insulated Piping, Component s (MS/HRH/C RH/Aux Steam lines,.....)	SSPC- SP3/Power Tool cleaning	Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744	2 (30 micro ns per coat)	-----	-----	-----	60
2	Uninsulated Piping, component s (Condensat e, Boiler Filling, HP/LP dosing, Lube oil, Piping.....)	Hand Tool/Power Tool Cleaning to SSPC-SP2	HB Chlorinated Rubber based Red Oxide Zinc Phosphate Primer	2 (50 micro ns per coat)	Chlorinated Rubber based finish Paint	2 (30 micr ons per coat)	Smoke Grey Shade No 692 of IS 5	160
3	Structures	Hand Tool/Power Tool Cleaning to SSPC-SP2	HB Chlorinated Rubber based Red Oxide Zinc Phosphate	2 (50 micro ns per coat)	Chlorinated Rubber based finish Paint	2 (30 micr ons per coat	Smoke Grey Shade No 692 of IS 5	160



			Primer			)		
4	Hangers & Supports- (CLH,VLH)	Abrasive Blast cleaning to Sa 2 (35-50 microns)	Epoxy Zinc rich primer to IS 14589 Gr.II, % VS = 35 Min	1 (40 microns per coat)	Aliphatic Acrylic Polyurethane paint, % VS = 40 min	1 (30 microns per coat)	Phirozi Blue Shade No. 176 of IS 5	70
5	Pipe Clams	SSPC-SP3/Power Tool cleaning	Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744	1 (30 microns per coat)	Synthetic enamel paint long oil alkyd to IS 2932	1 (20 microns per coat)	Smoke Grey Shade No 692 of IS 5	70
6	Stainless steel/Galvanized items	No Paint	No Paint	No Paint	No Paint	No Paint	No Paint	No Paint

17.3 Painting Of Steel Structural Works

17.3.1 All structural steel works covered in the civil scope in Volume V will be painted as specified in Volume V (Design, Fabrication and erection of Structural steel works)

17.4 Submission Of Painting Schedule

Contractor will submit a comprehensive painting schedule indicating surface preparation quality, paint applied, total DFT, colour code etc. for Customer/ consultant's approval before the painting of any equipment/ component/ structure etc.



**TECHNICAL SPECIFICATION FOR
SINGLE GIRDER CRANE
2X500 MW NNTPS (TG)**

SPECIFICATION NO. PE-TS-402-524-A001

VOLUME - IIB

SECTION - C

REV 00

DATE DEC 2014

ANNEXURE - V

Sl. No.	BHEL DRG.NO	DRAWING TITLE	REMARKS	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF P.O
1	PE-V0-402-524-A100/1	Manufacturing Quality Plan with sub vendor list for single girder EOT crane	APPROVAL	2
2	PE-V0-402-524-A101	Data sheet of Single Girder Crane with painting details	APPROVAL	2
3	PE-V0-402-524-A102/1	GA. of Single Girder EOT CRANE along with CT festoon cable details	APPROVAL	2
4	PE-V0-402-524-A103	Mechanism Sizing Calculation	APPROVAL	2
5	PE-V0-402-524-A104	G.A. drg of Hoist with trolley wheel assembly	INFORMATION	3
6	PE-V0-402-524-A105	Bottom Block assembly	INFORMATION	3
7	PE-V0-402-524-A106	General arrangement for LT cable trailing for Single Girder crane	INFORMATION	3
8	PE-V0-402-524-A107	Schematic Circuit Diagram for following a) Main Protective panel & BOM b) Main hoist panel & BOM c) Cross Traverse and Long Travel panel & BOM d) Pendant and earthing.	APPROVAL	3
9	PE-V0-402-524-A108	Long travel Machinery Assembly with LT wheel assembly	INFORMATION	4
10	PE-V0-402-524-A109	Detailed BOM/BOQ for crane	INFORMATION	6
11	PE-V0-402-524-A110	General arrangement of panel & pendant push button	INFORMATION	4
12	PE-V0-402-524-A111	Cable sizing calculation and schedule.	APPROVAL	3
13	PE-V0-402-524-A112	O & M Manual	INFORMATION	8
14	PE-V0-402-524-A115	Erection procedure	INFORMATION	8

Notes:

1. BHEL/CUSTOMER SHALL COMMENT /APPROVE THE DRAWINGS WITHIN 15 DAYS OF RECEIPT OF DRAWINGS.
2. VENDOR SHALL RESUBMIT THE REVISED DRAWINGS WITHIN 7 DAYS OF RECEIPT OF COMMENTS.
3. INCOMPLETE DRAWINGS/DOCUMENTS SHALL NOT BE TREATED AS SUBMITTED.
4. MANUFACTURING SHALL BE STARTED ON RECEIPT OF CAT II APPROVED DRAWINGS.

DOCUMENT MANAGEMENT SYSTEM

1.0 Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>).



**TECHNICAL SPECIFICATION FOR
SINGLE GIRDER CRANE
2X500 MW NNTPS (TG)**

SPECIFICATION NO. PE-TS-402-524-A001

VOLUME - IIB

SECTION - C

REV 00

DATE DEC 2014

DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		LII	NLC (HQ)	NLC-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
2	Drawings / document for Approval/Information (First Submission)	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy + 1 print		Soft copy	Soft copy (S)	
3	Return with comments/approval	Soft copy (S)	Soft copy	Soft copy		Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
5	Drawings / documents for distribution (Approved by NLC, in cat. 1 or Received for Information)	Soft copy + 2 print (HQ+ Site)	Soft copy + 3 prints	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 10 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of submitting soft copy is to be taken as date of submission.
3. S – Source for generation of document.



**TECHNICAL SPECIFICATION FOR
SINGLE GIRDER CRANE
1X500 MW NNTPS (TG)**

SPECIFICATION NO. PE-TS-402-524-A001

VOLUME - IIB

SECTION - C

REV 00

DATE DEC 2014

TECHNICAL DATA SHEET FOR SINGLE GIRDER UNDERSLUNG EOT CRANE

S.N.	Description	Technical Particulars
1.0.0	GENERAL	
1.1.0	Name of Manufacturer	
	a) EOT Crane	*
	b) Runway conductors	*
1.2.0	WEIGHT OF EQUIPMENTS	
	a) Crane weight (Kgs.)*	*
	b) Weight of DSL (Kgs.)*	*
1.3.0	Design, fabrication and testing of crane conform to standard / code	IS-3177 & 807 (latest edition)
1.4.0	Number of cranes	One (1) 8T no. in DG room Two (2) no.s 5T in ACW pump house
1.5.0	Crane Classification	Group M5 of IS: 3177 – 1999(latest edition) for structure and machinery.
1.6.0	Type of service	-----Indoor-----
1.7.0	Type of Crane	EOT
1.8.0	Capacity (SWC)	One (1) 8T no. in DG room Two (2) no.s 5T in ACW pump house
1.9.0	Span and lift	As per crane clearance diagram attached
1.10.0	Load test	As per IS: 3177
1.11.0	Over Load Test	(125% of rated capacity-SWC)
1.12.0	Crane structure	Fabricated from rolled section (Box section/ I- section)
1.13.0	Design ambient temperature	50° C
1.14.0	Runway Rail	ISMB (Shall be provided by BHEL)
1.15.0	End carriage	
1.15.1	Material	M.S. as per IS: 2062, GR B
1.16.0	Main girder	
1.16.1	Type & Size	Fabricated from rolled section (Box section/ I- section)
1.16.2	Material	M.S. as per IS: 2062, GR B
1.17.0	Power supply	415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz, +3% -5% variation. Combined voltage and frequency variation 10% (Shall be arranged by Purchaser at 1.5 M above floor level / operating level)
1.18.0	Control Supply	110V (Shall be arranged by vendor)
2.0.0	CRANE PERFORMANCE	
2.1.0	Operation	Electrical -- From floor by means of Pendant Push Button controller suspended from panel
2.2.0	Crane speed with full load	
	a) Hoist (Full speed)	3.0 M/Min(with creep speed 10% of main speed through VVVF drive)
	b) Cross travel (CT)	10.0 M/min
	c) Longitudinal bridge travel(LT)	10.0 M/min
2.3.0	Hoisting Mechanism	Gear
2.4.0	Type of power transmission	Gear
2.5.0	WIRE ROPE	
2.5.1	Make	As per Sub-vendor list
2.5.2	Core / Construction	Steel core as per IS-2266 / 6 X 36
2.5.3	Wire rope dia. (mm)	*
2.5.4	Wire rope fall	*
2.5.5	Material	Plough steel
2.5.6	Tensile strength	160-180 Kg /mm ²
2.5.7	Min. Breaking load	*
2.5.8	Conform to (Std. / code)	IS-2266
2.6.0	LOAD HOOK / HOOK BLOCK	



TECHNICAL SPECIFICATION FOR
SINGLE GIRDER CRANE
1X500 MW NNTPS (TG)

SPECIFICATION NO. PE-TS-402-524-A001

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2.6.1	Make	As per sub-vendor list		
2.6.2	Type of load hook	Plain shank, Trapezoidal section-forged as per IS: 15560, with safety latch.		
2.6.3	Material of load hook	Forged steel		
2.6.4	Type of Bearing of hook suspension	Thrust ball bearing		
2.6.5	Make of Bearing of hook suspension	*		
2.6.6	Type and Material of hook suspension.	M.S. Fabricated		
2.7.0	ELECTRIC HOIST			
2.7.1	Model No.	*		
2.7.2	Duty	Class II (M5) as per IS: 3938 (latest edition)		
2.8.0	Type of DSL			
2.8.1	Long travel	PVC shrouded bus bar conductor type		
2.8.2	Cross traverse	Flexible cable with Taut wire / Festoon cable arrangement		
2.9.0	MOTORS	M.H.	C.T.	L.T.
2.9.1	Make	As per sub-vendor list		
2.9.2	Rating (KW)	*		
2.9.3	RPM	*		
2.9.4	Qty.	1	1	2
2.9.5	Minimum number of poles	6	6	6
2.9.6	Type	TEFC, Sq. cage induction type, S4 duty, 40% CDF		
2.9.7	Enclosure	IP-55		
2.9.8	Number of start	150 starts/Hr.		
2.9.9	Insulation	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.		
2.9.10	Margin	Maximum continuous motor ratings shall be 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.		
2.9.11	Over load protection provided	YES		
2.9.12	Ambient Design temperature	50°C		
2.9.13	Pull out torque for motor	Pull out torque to be not less than 275% of the full load torque corresponding to 40% CDF.		
2.10.0	LIMIT SWITCHES			
2.10.1	Location	M.H.	C.T.	L.T.
2.10.2	Qty.	1+1	1	1
2.10.3	Type	Snap action	Two way lever	Two way lever
2.10.4	Method of actuation	Snap action	Shunt type	Shunt type
2.10.5	Material of contact	Silver Cadmium		
2.10.6	Make	As per Sub-vendor list		
2.10.7	Control Voltage	110V		
2.11.0	Control panel	A suitable control panel will be provided comprising of main contractor, motor contactor, single phase preventor with overload relays, transformer, fuses, MCCB's, etc. Rectifier panel for brake shall also be provided		
2.12.0	BRAKES			
2.12.1	Location	M.H.	C.T.	L.T.
2.12.2	Qty. / Motor	1	1	1
2.12.4	Type	All brakes will be Electro magnetic type		
2.12.5	Capacity	150% FLT	125% FLT	125% FLT



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DATE DEC 2014

2.12.6	Size / rating	*	
2.12.7	Make	As per sub-vendor list	
2.13.0	GEAR (HOISTING)		
2.13.1	Make	As per sub-vendor list	
2.13.2	Type	Spur / Helical	
2.13.3	Material	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9	
2.13.4	Lubrication	Grease / Oil splash	
2.13.5	Reduction	*	
2.13.6	Bearing Make	*	
2.13.7	Bearing Type	Antifriction deep groove ball / roller bearing	
2.13.8	Hardness (BHN)	As per IS 3177 (Latest Edition)	
2.14.0	GEAR (L.T. & C.T.)		
2.14.1	Location	C.T.	L.T.
2.14.2	Make	As per sub-vendor list	
2.14.3	Type	Spur / Helical	Spur / Helical
2.14.4	Material	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9
2.14.5	Lubrication	Grease / Oil splash	Grease / Oil splash
2.14.6	Reduction	*	*
2.14.7	Bearing Make	As per sub-vendor list	
2.14.8	Bearing Type	Antifriction deep groove ball / roller bearing	Antifriction deep groove ball / roller bearing
2.14.9	Hardness (BHN)	As per IS 3177 (Latest Edition)	
2.15.0	WIRE ROPE DRUM		
2.15.1	Material	Fabricated from M.S. as per IS: 2062, Gr B and stress relieved or seamless pipe ASTM A106 / 53 Gr B	
2.15.2	Diameter	*	
2.15.3	Length	*	
2.15.4	Type	Flanged	
2.15.5	Type of grooves	*	
2.16.0	WHEELS		
2.16.1	Location	C.T.	L.T.
2.16.2	Diameter (mm)	*	*
2.16.3	Qty	*	*
2.16.4	Hardness	200 BHN (Max.)	200 BHN (Max.)
2.16.5	Material	EN8 / EN9	EN8 / EN9
2.16.6	Bearing make		
2.16.7	Bearing Type	Antifriction deep groove ball bearing	Antifriction deep groove ball bearing
2.16.8	Flange	Single flanged	Single flanged
2.16.8.1	Conform to IS	3177	
2.16.8.2	Wheel Base	*	
2.17.0	SHEEVE		
2.17.1	Material	Cast steel	
2.17.2	Groove dia/ O.D. (mm)	*	
2.17.3	Bearing make	As per sub-vendor list	
2.17.4	Bearing Type	Antifriction deep groove ball bearing	
2.18.0	CONTROL PANEL	* Fabricated from CRCA steel sheet min 2 mm thick. * Degree of protection shall be IP 55. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	



**TECHNICAL SPECIFICATION FOR
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1X500 MW NNTPS (TG)**

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2.18.1	Qty	One	
2.18.2	Make	As per sub-vendor list	
2.18.3	Location	On the crane	
2.18.4	Size	*	
2.18.5	Thickness of sheet	2 mm	
2.19.0	ISOLATING SWITCH		
2.19.1	Qty	One (1) no at 1.5 m from operating floor.	
2.19.2	Make	As per sub-vendor list	
2.19.3	Rating	*	
2.20.0	PENDANT PUSH BUTTON	Up /down / forward / Reverse push buttons (glow type). Indicative marking for easy operation shall be provided	
2.21.0	Cables	Power	Control
2.21.1	Make	As per Sub-vendor list	
2.21.2	Material	<u>Power cable:</u> Stranded aluminum conductor, cross linked polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC sheathed cables conforming to IS 7098 <u>Control cable:</u> 1100 V grade with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed cables conforming to IS : 1554 <u>Trailing cable:</u> 1.1 kV grade with highly flexible stranded tinned copper conductor, insulation of EPR (Ethylene-propylene Rubber) each individual core protected and covered and overall outer cover of poly-chloroprene rubber cable conforming IS: 9968 (Part-I)-1988.	
2.21.3	Type	*	*
2.21.4	Dearing factor to be considered	YES	YES
2.21.5	Voltage grade	1100V	
2.22.0	END STOPPER (LT)		
2.22.1	Qty.	4 Nos.	
2.22.2	Material	As per IS 2062	
2.23.0	BUFFER		
2.23.1	Location	CT	LT
2.23.2	Qty	Two	Four
2.23.3	Material	Rubber/Spring	Rubber/Spring
2.24.0	PAINTING	Refer painting specification	
2.25.0	Control for Hoisting operations	Thru' VVVF drives	
a.	Speed Control	Thru' VVVF with minimum 6 pulse design	
b.	Starting torque of VVVF	Upto 400% typical	
c.	Starting current	Less than 150 % of rated torque	
d.	Temperature	Capable of withstanding upto 50°C without derating	

Note:

- Bidder to confirm the compliance of technical details as mentioned against each item. Deviation, if any shall be brought out clearly.
- The bidder shall fill Technical details against each item marked (*), during detailed engineering only.
- In case of discrepancy between the Data sheet and requirement given elsewhere in the technical specification, the more stringent of the two as per the interpretation of purchaser shall be applicable.

Handwritten signature/initials

DRAWING No.
PE-DG-402-524-

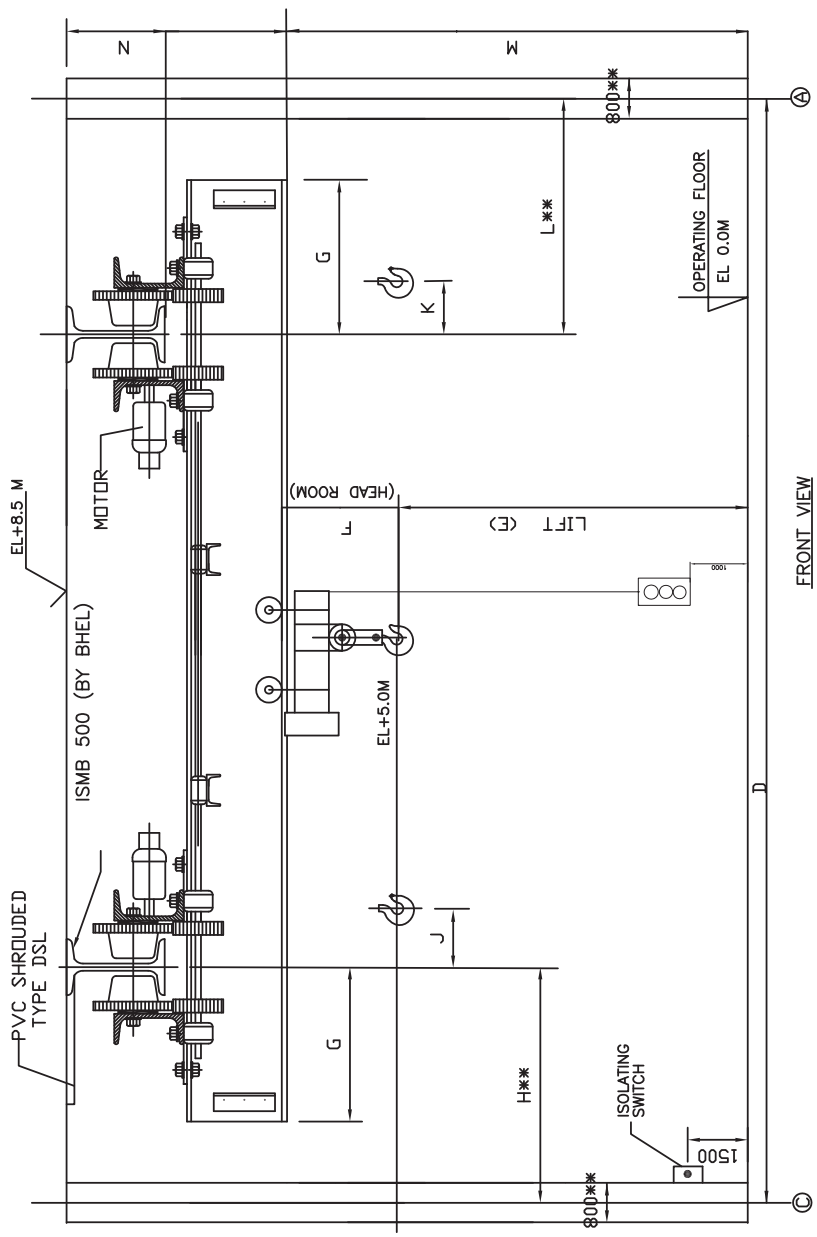
ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

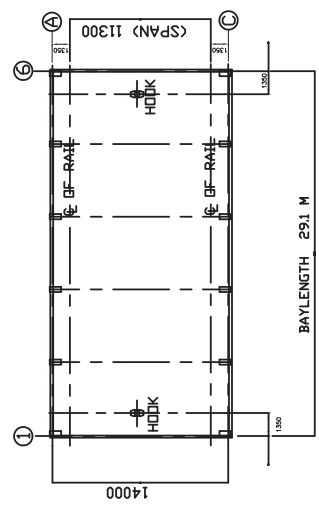
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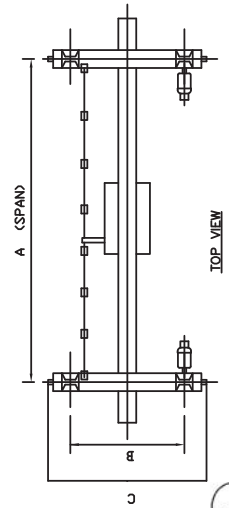
Fold-3



FRONT VIEW



KEY PLAN



TOP VIEW

CUSTOMER'S DRAWING No.	
DESIGN PARAMETERS	
A	11300
B	*
C	*
D	14000
E	5000
F	*
G	750
H	1350
J	200
K	50
L	1350
M	*
N	*

BAYLENGTH = 29.1 M
CAPACITY = 5.0 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG
2. ALL DIMENSIONS ARE IN MM.
3. BIDDER TO FURNISH LT WHEEL LOAD.
4. DIMENSIONS MARKED (**) DEPENDS ON FINAL CIVIL DRAWING.
5. THERE SHALL BE NO PRICE IMPLICATION FOR CHANGE IN LIFT/ & SPAN UPTO +/- 1 M

	CUSTOMER नेवेल्स लिग्नाइट कॉर्पोरेशन लिमिटेड (एनएलसी लिमिटेड)
	CONSULTANT LAHMEYER INTERNATIONAL INDIA
NEWVELL LIGNITE CORPORATION LIMITED (NLC LTD)	
लहमेयर इंटरनेशनल इंडिया प्राइवेट लिमिटेड	
M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD	
PACKAGE : TURBINE GENERATOR AND AUXILIARIES (NTA2)	
PROJECT NEWVELL NEW THERMAL POWER PROJECT (NNTPP) 2x500 MW LIGNITE FIRED UNITS AT NEWVELL	
BHARAT HEAVY ELECTRICALS LTD 2x500 MW LIGNITE FIRED UNITS AT NEWVELL PROJECT ENGINEERING MANAGEMENT NEW DELHI	
TITLE CRANE CLEARANCE DIAGRAM OF ACW PUMP HOUSE	
DRAWING NO. BHEL/SUB VENDOR DRG NO. PE-DC-402-524-A001	

Handwritten signature/initials

DRAWING No.
PE-DG-402-524-

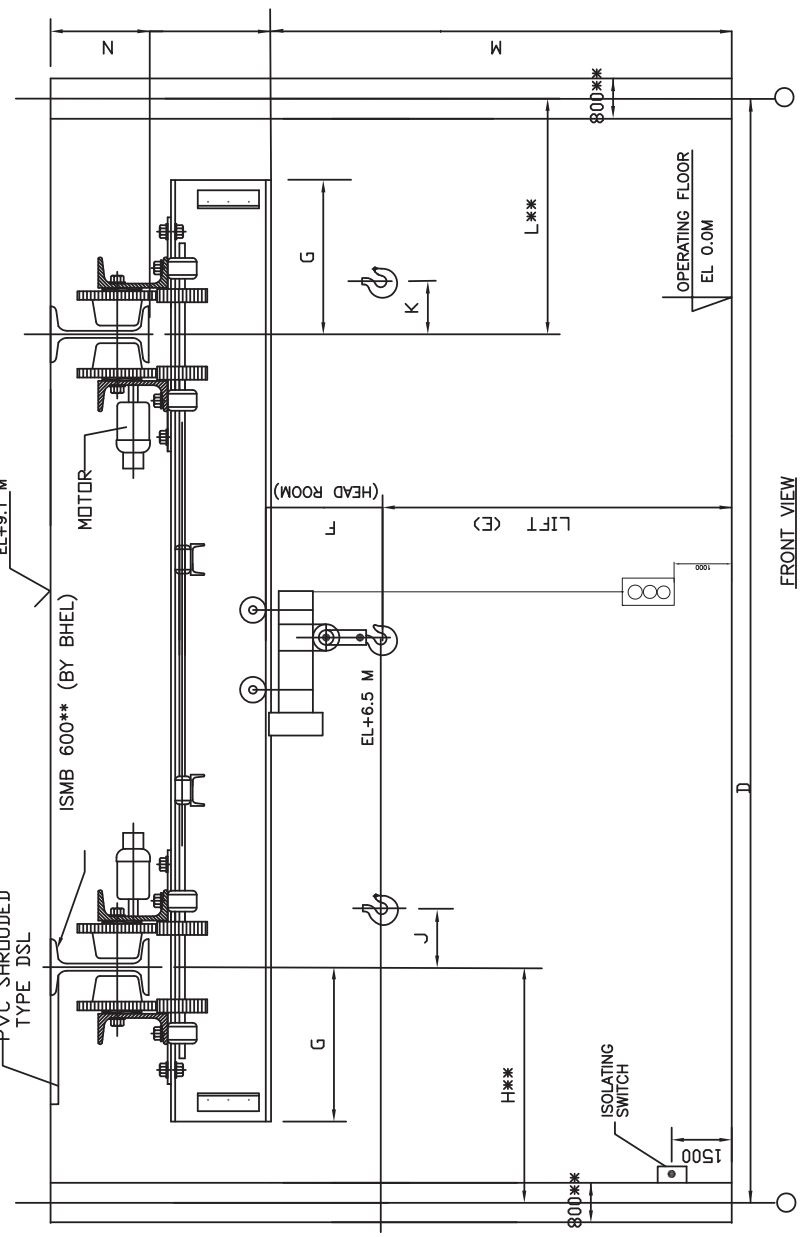
ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

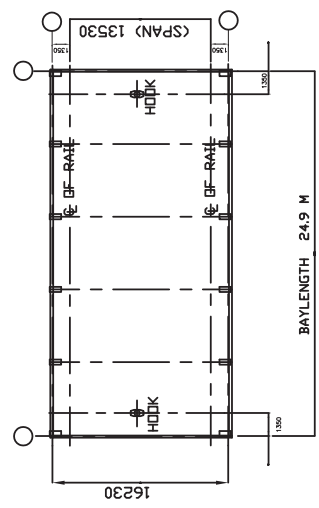
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Fold-2

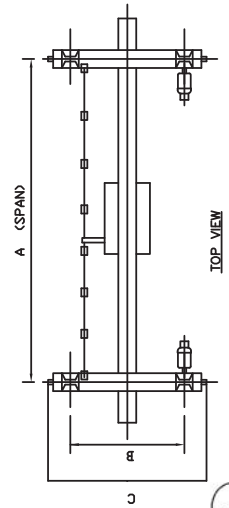
Fold-3



FRONT VIEW



KEY PLAN



TOP VIEW

CUSTOMER'S DRAWING No.	
DESIGN PARAMETERS	
A	13530
B	*
C	*
D	16230
E	6500
F	*
G	750
H	1350
J	200
K	50
L	1350
M	*
N	*

BAYLENGTH = 24.9 M
CAPACITY = 8.0 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG
2. ALL DIMENSIONS ARE IN MM.
3. BIDDER TO FURNISH LT WHEEL LOAD.
4. DIMENSIONS MARKED (**) DEPENDS ON FINAL CIVIL DRAWING.
5. THERE SHALL BE NO PRICE IMPLICATION FOR CHANGE IN LIFT / SPAN UPTO +/- 1 M

	CUSTOMER	नेवेल्स लिग्नाइट कॉर्पोरेशन लिमिटेड (एनएलसी लिमिटेड)
	NEWVELL LIGNITE CORPORATION LIMITED (NLC LTD)	
	CONSULTANT	लहमेयर इंटरनेशनल इंडिया प्राइवेट लिमिटेड
	M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD	
	PROJECT	PACKAGE : TURBINE GENERATOR AND AUXILIARIES (NTA2) NEVELL NEW THERMAL POWER PROJECT (NNTPP) 2x500 MW LIGNITE FIRED UNITS AT NEVELL
	PROJECT ENGINEERING MANAGEMENT NEW DELHI	
	TITLE	CRANE CLEARANCE DIAGRAM OF DG ROOM 8T SINGLE GIRDER UNDERSLINGING CRANE
	DRAWING NO. BHEL/SUB VENDOR DRG NO. PE-DC-400-524-A002	



NLC SPECIFICATION





11.1. GENERAL

CRANES:

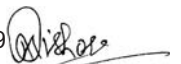
Sl no.	Description	Qty.	Location
1	8T capacity single girder underslung EOT Crane	1 No.	In DG building
2	5T Single Girder Electrically operated under slung Crane	1 No.	ACW pump house

11.2. CODES AND STANDARDS

The design, manufacture and testing of the crane(s) will conform to the latest editions of the following codes and standards in general.

S.No	Code	Description
1	IS: 807	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2	IS:3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than Steel Works cranes
3	IS:1835	Steel wires for Ropes
4	IS:2266	Steel Wire Ropes for General Engineering Purposes
5	IS:3443	Crane Rail Sections
6	IS:15560	Point Hook with Shanks for General Engineering Purpose
7	IS:325	Inductor Motor
8	IS:816	Code of Practice for use of metal Arc Welding for General Construction in Mild Steel
9	IS 9595	Code of practice for Use of Metal Arc Welding of Mild Steel
10	IS: 7318(P1)	Qualifying Tests for Metal Arc Welders (Engaged in Welding Structures other than pipes)
11	IS:1323	Code of Practice for Oxy
12	NEC:1985	National Electrical Code
13	CMAA	Codes & Standards for design, manufacture, erection & testing of Cranes

- All electrical installation work will comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.
- ANSI-B30.2.0- Safety codes for overhead and Gantry Cranes



- c) Equipment and materials conforming to any other standard that ensures equal or better quality may be accepted. IN such case, copies of the English version of the standard adopted will be submitted along with the bid.
- d) In case of any contradiction between the above-mentioned codes and standards technical specification requirements, will prevail.
- e) The electrical installation will meet the requirements of Indian Electricity Rules as amended up to date.
- f) ANSI-B30.2.0 – Safety codes for overhead and Gantry Cranes
- g) Equipment and materials conforming to any other standard that ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted will be submitted along with the bid.
- h) The electrical installation will meet the requirements of Indian Electricity Rules as mentioned up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work will be followed. In case of any discrepancy, the more restrictive rule will be binding.

11.3. SCOPE of EOT CRANE

11.3.1. Scope of Work

Scope of Work includes supply of the following:

- a) Single girder cranes will be supplied complete with all accessories under this specification and will include, but not be limited to the following for each crane.
 - One (1) set of bridge girders complete with bridge rails, end stops, walkway platforms, access ladders, curved rail bent wheel stoppers for trolley etc.
 - One (1) set of end carriages complete with minimum four (4) wheels for each end carriage and access ladders from gantry platforms, spring buffers etc.
 - One (1) trolley with wheels and drive equipment for hoists and trolley drives complete with motors, gear reduction boxes, brakes, shaft bearings, limit switches etc.
 - One (1) – set of crane longitudinal drive equipment complete with motor, gear reduction boxes, brakes, shaft bearings, gear pinions, limit switches etc.
 - One (1) – Lot crane runway gantry rails complete with fixtures comprising of fixing clamps (machined to suit rail flange contour) bolts, nuts etc. for effective crane longitudinal runway length specified.
 - Runway conductors (DSL) for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete with installation. Power supply cabling including isolating switch complete with electrical items, attachments and accessories as required to feed power to the runway conductor from Employer's terminal point.
 - End stops & curved rail bends for crane longitudinal travel.
 - Set of electrical conductors thru festooned/flexible trailing cables with Coburn track and trolley complete with fixtures arranged along bridge for power supply to trolley.
 - Set of limit switches, electrical protective gear and various other needed electrical/control accessories.
 - Complete electrical works including main disconnect, distribution boards, protective and control panel, controllers, pendant PB stations, resistors, conductors, insulators, protective and operating devices, cables, current collectors, cabling/wiring, grounding





and illumination as may be necessary for the efficient, safe and satisfactory operation and maintenance of the crane.

- One (1) – Operator's cabin complete with accessories and attachments of the operation of the crane.
- Bridge and trolley current collectors and bridge cross conductors along with all wirings etc. for the crane as specified and as required to complete the scope of work.
- Operation and maintenance instruction manuals and drawings.
- Flushing oil and lubricants will be provided by the Contractor till commissioning.
- Crane components will be provided with lifting lugs, eye-bolts etc. at suitable locations for handling, assembling, lifting and placing into position.
- Paints and primers for painting at shop and at site and final painting will be as per the details given in painting section of NTA2 package.
- Training of Employer's personnel during testing and commissioning till the crane is taken over by the Employer.
- Hoist assembly will be provided with motors for creep & inching operations.
- Complete cleaning, protection and painting.
- Any additional equipment and materials or work which are not specifically mentioned, but are required to make the installation complete in every respect, will lie under the scope of this specification.

11.4. DUTY AND CAPACITY OF EOT CRANE

Normally the cranes are operated intermittently for one (1) shift only, however during overhaul and maintenance of the equipment, the EOT crane may be required to work for all three (3) shifts on intermittent duty and should therefore be capable of such operation.

11.5. SPECIFIC REQUIREMENTS OF EOT CRANE

The specific requirements for individual cranes are given in the Data specification sheet and crane clearance diagram enclosed with this specification. In case of conflict between this specification and the data specification sheet, the latter will prevail.

11.6. DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES OF EOT CRANE

11.6.1. General

Drives will be designed with adequate margin to give best performance and efficiency. Safety arrangements will be incorporated to prevent damage to motors on account of mechanical overload and electrical faults and to gearing, shafts, etc. due to over stressing and other detrimental conditions.

The crane will be rigid in construction and all movements will be smooth and non-jerky.

All materials will be of tested quality and will conform to the specification requirements and standards mentioned and will be new and first class in all respects.

Casting and forgings will be of testes quality and will conform to their respective material specifications and will be free from flaws and objectionable imperfections, machined true and in a workman like manner.

No wood or other combustible material will be used unless specifically mentioned and approved by purchaser.





Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings will be submitted to the employer and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs will be submitted to the employer.

All fabrication by welding will be carried out by qualified and certified welders as per IS: 7318 (part 1).

Design will provide for easy maintenance of all parts, particularly the wheel bearings on end trucks.

The Contractor / Supplier will ensure that the crane will be manufactured as per the tolerances specified below:

i)	Span over LT wheels	: ± 6 mm upto 40 meters
l)		
ii)	Wheel base	
	LT	: ± 5 mm
	CT	: ± 3 mm
iii)	Difference in diagonal	
	LT	: ± 5 mm
	CT	: ± 3 mm
iv)	Long travel wheel alignment	: ± 1 mm
v)	Tilt of wheels or balancer axle	: ± 1 mm/ 1000 mm (Horizontal & Vertical)
vi)	Trolley wheel gauge	: ± 3 mm upto 7500 mm span ± 5 mm above 7500 mm span
vii)	Trolley track gauge	: ± 3 mm upto 7500 mm span ± 5 mm above 7500 mm span
viii)	Difference in height between trolley rails (H) in relation to the trolley track gauge (S) will be within the following tolerances.	
	'S' (mm)	'H' (mm)
	Upto 2500	: 4
	Above 2500 and upto 4500	: 6
	Above 4500	: 10
ix)	Horizontal bend of girder in plan	: Span/2000
x)	Shift of the web plates of main & end girders from vertical over height 'H' measured near the mid span & close to the main diaphragm.	: H / 200
xi)	Twist of the main girder	: Span/1500



xii)	Axis of the flange plates from the axis of the beam	:	H /250
xiii)	Tolerances on camber		
	Upto 4 mm	:	+ 4 - 0
	Above 4 mm and upto 8 mm	:	+ 5 - 0
	Above 8 mm and upto 16 mm	:	+ 6.3 - 0
	Above 16 mm and upto 31.5 mm	:	+ 8 - 0
	Above 31.5 and upto 63 mm	:	+10 - 0
xiv)	Over buffer length (Over buffer dimension on two sides will be same)	:	± 5 mm
xv)	Height of centre of buffer (from the top of track rail)	:	+ 5mm

11.6.2. Temperature Effects

Where any portion of the structure is not free to expand or contract under variation of temperature, allowance will be kept for stress resulting from these conditions: the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel.

Maximum use will be of shop fabricated sub-assemblies.

Alternative design to those prescribed in specifications will be considered only if found technically suitable and acceptable to the employer in light of the requirements accompanied by substantial reduction in cost.

11.6.3. Material of Construction

The material of construction of the major components of the crane will be as indicated in the data sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of the employer after furnishing chemical and physical properties of the offered material and any other information that may be asked for the employer.

11.6.4. Load Indication

The crane bridge will have permanent inscription in English on each side, readily legible from operating floor, stating manufacturers name, serial no, the year of manufacture and the safe working load.

11.6.5. Structural Design Consideration

**a) Minimum thickness of metal**

For load carrying members, the component plates, bars, angles and other rolled sections will be minimum 8 mm thick. For tubes having both ends sealed the minimum thickness will be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness will be 8mm. The chequered plates for platforms will be minimum 6 mm thick over plane.

b) Accessibility for maintenance

All structural parts will be designed so that they are accessible for periodic cleaning, brushing and painting. All rivets/bolts will also be accessible for periodic checking.

c) Ruling dimensions and ratios

- For compression members, the slenderness ratio will not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio will not exceed 180.
- For girders, the following values of maximum span to depth ratio will be governing as per IS: 807:

Plate girders	:	Span/depth = 18
Lattice girders	:	Span/depth = 12

d) Connections

- Unless otherwise specified and agreed by purchaser, only riveted or welded joints will be used.
- Where welding or riveting is not practicable, turned or fitted bolts will be used with the approval of Purchaser/consultant.
- Minimum number of rivets or turned or fitted bolts in a connection will not be less than two.
- Black bolts will not be used in main structures and high tensile bolts will not be used unless approved by the Employer. Bolts will preferably be not used in tension.
- Where bolts pass through sections having tapered flanges, tapered flats will be welded to inside of the flanges. Tapered washers will not be used.
- Transverse fillet welds on load carrying members will be avoided. If side fillets are used in end connections, the length of each side fillet should be not less than the edge distance between the fillets.
- Butt welds on structural members under tensile stress will be checked by Radiographic examination as and when directed by the Employer.
- Splices will be designed to resist one and half times the forces and moments to which it is subjected, but in no case it will be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders will be designed for full strength of the web in shear as well as bending. For splicing tension members, the net section of the splice plate will be ten percent more than that of the material spliced. Splices will be proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.

e) Deflections and Camber

- The total maximum vertical deflection of the girders for the live load plus trolley and not including impact or dead load of the girder will not exceed limit of Span/900.
- The girders will be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

11.6.6. Mechanical Details



Material of Construction will be selected for cranes operating in non hazardous area and relevant IS for each part.

a) Rope drums

Rope of drums will be as per IS 3177. It will be either Seamless pipe of cast steel or fabricated out of rolled steel plates. Fabricated drums will be 100% radiographed and stress relieved before machining. The grooves of the drum will be machine grooved and smooth finished. Rope drum will be flanged at both ends. The cable reeling drums (wherever provided) will be positively driven.

b) Rope sheaves

Rope sheaves will be of cast steel or fabricated out of rolled steel plates.

c) Wire rope and Hook Block Assembly

- One (1) set of wire rope of entire length required for the lifting of main hooks will be provided.
- The sheaves of the hook block will be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands.
- All sharp edges on the hooks will be eliminated to prevent damage to the sling ropes. The hooks will conform to the requirements of IS: 3177 and IS: 15560.
- The ropes will be hemp cored for all cranes. Ropes will be regular right hand lay as per IS: 2266-1989. The construction of the ropes will be 6 x 37 upto 16 mm diameter and 6 x 36 above 16mm diameter. The rope length will be sufficient so that 2 full lap will remain on drum at the extreme low position of the hook. The braking loads for the hoist rope will not be less than the load factor specified in IS 3177.

a) Gears & gear- boxes

Straight and helical spur gearing will be used for all motions. Worm & bevel gearing may be used in exceptional cases with the specifics approval of the Purchaser. All first reduction gears will have helical teeth. All pinion will be integral with the shaft.

All gears will be hardened and tempered alloy steel, heat treated and confirming to IS: 4460 having metric module. Overhung gears will not be used.

Surface hardness for pinion will be 255 to 300 BHN and for gears it will be 215 to 260 BHN. Difference in hardness of pinion and gear will not be less than 20 BHN. All cast steel gear will be tested by Gamma Ray. All gears will be enclosed in oil tight gear boxes. Gear-boxes will be of high Grade/cast steel or fabricated and split at each shaft centre lines. Fabricated gear boxes will be stress relieved before machining. For cross travel and long travel motion, vertical gear-boxes with 'T' split may be used.

b) Connection between rope drum & gear-box

One of the following arrangements will be adopted for connecting the rope drum with the gear- box.

- Flexible joint, incorporating flexible geared coupling housed within the drum.
- Fully flexible geared coupling between the drum & gearbox.

Drive of the drum by means of spring mounted on the drum will be avoided as far as practicable.

c) Wheels

Wheels will be mounted in anti-friction roller bearing housed in 'L' shaped bearing brackets for easy removal during maintenance. Flangeless wheels with guide rollers are also acceptable.



Solid wheels will be of forged rolled / cast steel. The hardness of the wheels shall be between 300-350 BHN with a depth of hardening 10mm.

d) Coupling

Motor shaft will be connected to the gear-box input shaft through flexible shock absorbing coupling excepting pin bush type. Rotating parts will be suitably covered by minimum 3.15 mm thick sheet steel hinged covers for safety. In case of single motor central drive for long travel motion, output shaft of the gear-box will be connected to the line shaft through half geared couplings. Intermediate lengths of the line shaft may be connected through solid flange couplings. Half geared couplings with floating shaft will be provided between the wheel and the line shaft.

e) Bearings & bearing housing

Anti-friction bearings will be used throughout except where required otherwise for technical reasons.

f) Buffers

Spring loaded/hydraulic type rubber buffers will be provided on all the 4 corners of the bridge girders and the end carriages for cross and long travel motions respectively based on the duty class of the crane whereas rubber buffer may be used for class M3 and M5 duty cranes. Amount of impact forces will be decided depending upon the type of buffers selected.

g) Bridge Girder and End Carriage

- The bridge girder will be box section type or braced i - beam type as per standard design practice. The exterior surface will be smooth and as free as possible from projections etc. to minimize dust collection on it.
- The crane bridge will be carried on end trucks of suitable design. Each end truck will be built up from steel plates welded together to form a closed box section with opening at each end to receive the wheels. Welded to the trucks will be steel sections to form bearings for the wheel axles and the driving shaft. End trucks will be provided with rail sweep and bumper. They will also be provided with suitable jacking pads for maintenance of the wheel and bearings. The location of the jacking pads will be such that it will not interfere with the maintenance of the wheels and its bearing.
- Driving wheels will be of the double flange and taper tread type and will be ground to equal diameter in pairs. Wheel axles may be either of the stationary or rotating type as per standard practice. If stationary type, they will be prevented from turning in the truck by means of a key plate fitting into a slot in the end of the axle and if rotating type, wheels will be keyed to them.
- Where more than two bridge wheels are used per end truck, the end truck will be split into two sections, each carrying one bridge independent of other. Two sections of the end truck will be joined by suitable joining device that will ensure uniform wheel loading. Steel pads will be welded on the tops of end trucks where the girder rests and will be machined to receive the girder ends.
- Trolley travel rail ends will be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed.
- End trucks will be equipped with spring/rubber buffers and rail sweep for bridge travel. The rail sweep will be such that it can push away any object that may fall on the runway. The buffers will be of substantial design and suitable for engaging the stops at the end of runway.



- Breathing holes will be provided in completely enclosed welded box type girders. Drain holes will be provided in all places where water or oil is likely to collect where practicable, means of access will be provided for inside inspection of completely enclosed box girders.
- In bridge girder strength calculations, the trolley rails and chequered plates will not be considered as load carrying members.

h) Wheel Stops

Bridge and trolley wheel stops will be provided before the end stops. These will match to wheel radius. Wheel stops to prevent rails from creeping and trolley from running off the bridge will be abutted against ends of rails. Wheel stops will be welded to the girder.

Sweeps will be attached to the end carriages and to the trolley, to remove foreign material from the rails.

i) Brakes

All brakes will be of 'fail-safe' design and will operate automatically in case of power failure. Hoisting brakes will be designed to hold 1.5 times full load torque while cross travel and long travel brakes will be designed to hold 1.25 times full load torque.

j) Lubrication

Grouped lubrication system will be used for the cranes. Lubrication of the gears and pinions in the gear-boxes will be splash fed from the sump. In case of three reduction, vertical mounted gear-box (having limited motion), are used, an oil pump will be fitted to ensure lubrication of all gears.

k) Trolley Frame

- The trolley frame will be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction and should be covered by flooring as far as possible.
- On bottom of trolley frame, on each side a double spring bumper will be provided to engage stops at each end of the bridge.
- Equalizer sheaves will be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves is not directly transmitted to the hoisting mechanism.
- Sheaves will be so arranged on the trolley that rope reeling arrangement resulting there from will ensure a lifting of the load in almost a vertical line with minimum of swing or side-movement.

l) Trolley Rail

- The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.
- The length of the rail supplied will be adequate for maximum permissible trolley travel. Gap between successive rails will not exceed 2 mm and end rails will be provided with stoppers to prevent longitudinal shifting.

m) Tolerances

The limits of tolerance as specified in the Data Specification Sheet will be observed.

n) Rail End Stops

Rail End Stops of adequate design will be provided on both ends of the runway. The end stop location and arrangement will be such that the unavailable length of runway (for crane operation) on any end is a minimum.

**o) Drive Mechanism**

- Equal driving effort will be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.
- For bridge, the torsional deflection in the cross shaft will be limited to safe value.
- For bridge drive if twin motors are used, these motors will be equidistantly located at each wheel end. Suitable interlock will be provided to prevent single motor operation at any time.
- Trolley drive will be achieved by single motor in which the motor will drive a common output shaft through proper gearbox and traction power will be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.
- All machineries for the drive unit will be properly aligned. Self-aligning type gear couplings will be used between connection shafts to take care of transverse as well as axial movement wherever necessary. Wherever components of considerable amount of inertia is directly mounted on the high speed shaft (e.g. brake drum, couplings, etc.) they will be balanced statically to minimize vibration.
- Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified. Further, the hoist motors will be rated to lift 125% of the design load on the hook at the rated speed.
- Along with the drive mechanisms adequate brakes will be provided as detailed elsewhere in this specification. Selection and design of brakes will be the complete responsibility of the manufacturer. The brakes will be of accurate rating to stop each motion within a very short distance and in a safe and smooth manner.

ELECTRICAL DETAILS:**Scope of Supply**

The scope of supply covers all electrical equipment commencing from Power Distribution Board (PDB), Isolator, cables, complete down shop leads (DSL) system in the shop and main current collectors on the crane and all other electrical items beyond the main current collectors of the crane i.e. DSL main current collectors, power disconnecting switch on bridge platform after main current collectors, protective and control switch gear, motors, VVFD, control and brake panels, resistors, brakes, limit switches, all power and control cables, socket outlets, lighting distribution panel and lighting fixtures with lamps, festoon cable system for crane trolley magnet/ grab and cable reeling drum, if specified for grab/magnet, master controllers, indicating lamps, push buttons, earthing materials etc. The scope of work also includes complete assembly and wiring of crane and testing at manufacture's works, erection and testing and commissioning of all electrical equipment, supply of all commissioning spares with minimum quantities as indicated in T.S.

All sundry erection materials required for installation and connecting up of electrical equipment with cable laying and fixing accessories will be included in scope of supply by Contractor.

Power supply to the crane will be from the 415V station PDB/ACDB meant for Crane/Hoist etc., as shown in the Electrical SLD.

Power supply and standard voltage levels

The following standardized voltage levels will be adopted:





- a) LTAC : 415V, 3 phase, 50 Hz, 4 wire solidly earthed system. Power supply be made available at this voltage only.
Other voltages will be obtained by providing transformer/ transformer – rectifier unit with MCBs on both primary and secondary side and $\pm 5\%$ and $\pm 10\%$ taps on transformers secondary.
- b) AC control and signalling voltage : 240 V, 110 V AC
- c) Socket outlets for Hand lamps : 24 V, single phase, 50 Hz, AC obtained through suitable transformers
Hand tools : 240 V, 15A, 2 pin plus earth with plug interlocked switch
- d) Electro-magnetic brakes : 220 V, DC obtained through individual brake control panels.
- e) Monitoring and signaling in electronic installations, mimic panels : 24/ 48 V. DC
- f) Illumination/ lighting : 240 V, AC
The three phase symmetrical short-circuit ratings of the switch gear at 415 V will be 50 kA for 1 second.
The system/ unit/ equipment will be designed so as to be suitable for the following variations in voltage and frequency :
- | | Voltage | Frequency |
|---|----------------|------------------|
| Permissible variations with rated performance, rated current and control effectiveness maintained | $\pm 10\%$ | +5% & -5% |
| For LT system | | |
| Permissible variations for control and regulation equipment with rated performance and control quality maintained | $\pm 10\%$ | +3% & - 6% |

Voltage dip on the starting of largest LT motor will be limited to 15% of the nominal voltage at the motor terminals. Total voltage dips on starting of large motors on crane will be limited to 3% on crane and 6% in DSL system.

Standards

The design, manufacture, assembly and testing as well as performance of the equipment will conform to the relevant IS specifications (latest revision). In case the Contractor is not in a position to comply fully with certain BIS specifications, or in respect of certain items for which there are no IBIS specifications, the Contractor may base his proposals on IEC recommendations or other reputed national or international standards subject to the approval of the Purchaser.

All equipment supplied and all work done including system design and detailed engineering will also comply with the statutory requirements of the Government of India and the Government of Tamilnadu and with the Indian Electricity Rules





Wherever specified, a set of batteries, a battery charger, one annunciation system and other accessories will also be provided along with magnet so that the magnet can hold the full load for atleast half an hour in case of power failure.

Equipment in operator's cabin and on pendant unit

a) Following will be included on the pendant unit:

Push button for	Hoist slow, hoist fast, lower slow, lower fast, left cross traverse, right cross traverse, forward long travel, backward long travel, emergency stop conditions.
Switch for	Lights and bells
Lamps for	Power 'ON' indication and emergency corner switch operation.

The Pendant Push Button station will be supported independently, earthed separately independent of suspension.

b) Cabin operated cranes:

The operator's cabin will contain the following:

- Master controllers for all the motions and magnet (wherever applicable).
- Emergency stop push button.
- Foot switch for alarm or bell.
- Switches for all lighting equipment on crane.
- Switches for exhaust fan and for cabin fan and air conditioner.
- A fire extinguisher.
- Insulating mat and operator's chair.
- Cabin light and fan.
-

Annunciation panel with indication lamps for power 'ON' control 'ON' emergency corner switch operated, ammeter and voltmeter with selector switches.

c) Enclosure Class

- a) For indoor operations
- Resistance boxes : IP : 11
 - Motors : IP : 54
 - All other electric equipment : IP : 54

Cables

Power cable suitable for 3 Phase, 4 wire, AC power supply system.

All cables will have stranded copper conductors. Control wiring will be with 2.5 mm² copper; minimum size of power cable will be 6.0 mm². Fixed wiring on cranes will be carried out with PVC insulated. PVC sheathed armoured cable or EPR insulated CSP sheathed cable or better.

All flexible cables (i.e. cables for magnet, trolley, feed, pendant unit etc.) will have copper conductor, EPR insulation and CSP sheathing or better.

All cable will be suitably de-rated for grouping and higher ambient temperature.



All cables will be of 1100 Volts grade.

All accessories like cable glands, clamps, pipes, wire and terminal marks etc. will also be provided.

Cable laying and terminations will be such that the chances of cables getting damaged is remote.

Cable sizes will be selected considering motor rated current.

In all passages and on trolley the cable will be laid in trays and will be covered by similar trays and properly clamped & fixed.

a) LT Power Cable

1.1 kV, heavy duty power cable, 4/3.5 core with stranded sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Copper conductors as applicable, PVC insulated suitable for type – ST2 operation as per IS:5831-1984, core stranded together provided with a common covering of Extruded PVC inner sheath, galvanized round steel wire / strip armoured and Extruded FRLS PVC outer sheathed, multi core conforming to IS:1554 (Part-I – 1988) Type TWY.

b) Control Cables

1.1 kV, circular stranded (rm), annealed copper conductor, PVC insulated suitable for type ST1 (70°C) operation, as per IS:5831-1984, cores stranded together provided with a common covering of PVC inner sheath, galvanised round steel wire armoured and Extruded FRLS PVC outer sheathed, multi-core similar to IS:1554- (Part-I)-1988, Type YWY.

c) Flexible Trailing Cable

1.1 kV grade, heavy duty type with tinned annealed high conductivity flexible copper conductors, ethylene propylene (EPR) insulated and chlorosulphorated polyethylene (CSP) sheathed conforming to IS:8130-1984, IS:6380-1984 and IS:9968 (Part-I)-1988.

Earthing

A ring earthing system will be provided on the crane. Each and every electrical equipment will be connected to this earthing at least at two points. However the electronic circuit insulated earth wire will run in panel and terminate at main earth connection only at one point. The earthing will be connected to the fourth trolley line in DSL system through 2 nos of current collector. Additionally current collectors will also be provided on crane rails for earthing on crane . All these collectors will be connected to earthing ring.

An earth core will be provided in trolley feed cable and the magnet. The cable reeling drum will have a separate slipring for earthing purpose.

It will conform to general specification for earthing.

Rubber mattings will be provided in front of the protective and control panels.

All bonds between earth conductors and crane parts will be welded if possible, or rivetted and soldered. Where screwed bonds are made, care will be taken that there is satisfactory contact surface and nuts will be locked to prevent their loosening? Earth connections to equipment will be made by means of multi strand flexible conductor to adequate section.

The earth ring on the crane/ machine will be connected to the plant earthing system through to gantry rails. Each end of each gantry rail will be bonded to the plant earthing system.

In addition, intermediate earthing bond will also be provided on the rails at every 60 m in case of longer tracks.

Flexible copper bonds will be provided across any gap in the running gantry rail. For mobile equipment with flexible cables, one separate copper conductor of adequate size will be provided for earthing.



11.6.7. Operation

The crane will be operated from a pendant control station.

11.6.8. Operator's Cabin

- a) The operator's cabin will be steel fabricated open type, suitable for indoor service, and air conditioned, fire proof construction and complete with light, fan and seat. The cabin will be located on one end of the crane bridge and on the opposite side of Down Shop Lead (DSL) and under one of the bridge girders, so that it is offset to one side. The cabin will be provided with guarding handrails and the floor will be covered with electric insulating carpet. A clear headroom of 2300 mm will be ensured within the cabin. The cabin will be well braced in order to provide adequate strength and rigidity. The outside surfaces of the cabin and floor beams will present smooth and pleasing appearance.
- b) A foot operated type-warning gong will be provided within the cabin. The cabin will be compact and adequately sized (approximately 2.5x2x2.3 meters dear high) to accommodate controllers, protective panel, distribution board and other accessories required for operating the crane. Arrangement will be such as to provide unrestricted view of load at any position to the operator.
- c) Dead man's Handle/Control for each of the crane motions will be provided in the cabin.
- d) Cabin's platform will be provided with 10 mm thick rubber sheet on the floor to comply with I.E. Rules. No wooden paneling will be permitted. The sides of the cabin will be covered with plate steel to a height of one (1) metre. The floor will be designed for a load of 300 kg per metre square of floor area exclusive of the weight of any equipment mounted on or attached to the cab. An access ladder will be provided from the bridge girder to the Operator's cabin.
- e) In addition to above, accessories not limited to the following will be adequately arranged/ mounted in the cabin:
 - Manually operated master control switches, main line disconnecting switches and other necessary controls and wiring with fittings.
 - A swing way operator's chair.
 - Complete concise instructions covering the crane operation, maintenance and periodical lubrication etc typed in English and neatly framed in a permanent frame for each reference.
 - A non-oscillating-ventilating fan having 350 mm swing (240V AC, single phase) with suitable guard, and separate regulator.
 - Adequate fluorescent illumination with switch inside the cabin.
 - An electric alarm gong and an additional 300 mm dia hand operated metal gong.
 - Portable carbon dioxide fire extinguisher and sand bucket.
- f) Location of the cabin will be on one side of the crane so as to permit maximum visibility of all operations of the crane. Location of cabin and/or access ladder will be such as to prevent personnel from making accidental contact with crane and/or trolley runway conductors.
- g) Enclosure protection class of all Electrical equipment will be at least IP 54 or better except that for motor which will have IP-55 protection & Resistance boxes, which may have IP-23 protection.

11.6.9. Pendent Station

- a) The pendent station will locate the push buttons for controlling the various motions of the crane and will be hung from the crane trolley to a height of approximately 1 metre above the operating floor.





- b) With pendent operation, foot operated travel brake and the drum controllers need not be provided.

11.6.10. Repair Cage

- a) A repair cage will be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards will be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage will be provided on the trolley to attend to these conductors.
- b) Repair cages will also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.
- c) The repair cages will be adequately sized, guarded for safety and correctly located for the intended service. Suitable access to the cages will be provided.

11.6.11. Guarding

- a) Guards of an approved design, which will push forward or off the rail track any object placed across it, such as person's foot or arm, will be attached to each end of the end carriage.
- b) Protection guards to live electrical wirings/conductors will be provided.
- c) Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, will be provided.
- d) The sheaves of the hook block fitted with two sheaves or fewer will be guarded to prevent trapping of a hand between a sheave and the in running rope.
- e) Effective means of guiding the wire ropes over the sheaves will be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.
- f) All openings in foot walk flooring, for access to bottom chord platform, if any, and to other inspection platforms, will be provided with covers having suitable locking means to avoid any accidental opening.
- g) All electrical panels, resistance boxes and crane trolley wires will have suitable rain/dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before the completion of the building roof.

INSPECTION AND TESTING

The crane will be offered for inspection and testing during different stages of its manufacture, starting from raw materials till the completion of the crane, by the Purchaser/consultant /his authorized representative at the Supplier's or his sub-supplier's works as per the inspection procedure mutually agreed between the Purchaser or his authorized representative and the Supplier. Inspection will be regarded as a check up and will be in no way binding on the Purchaser.

Documents for all electrical and mechanical equipment supplied with the crane will be put up for inspection along with the equipment.

After inspection, an endorsement would be made in the inspection certificate about the availability of the documents.

The crane will be completely assembled and tested in the Supplier's works for full load and 25% over load on hoisting and cross traverse motion, in presence of Purchaser's / Consultant's





representative in addition to other tests as specified in the latest revision of IS : 3177 as applicable.

The following test will be carried out at manufacturer's works during inspection.

- High voltage test of panels.
- Contactor sequence test for all motions.

Necessary clearance from statutory authorities (if any) will be obtained by the Contractor on behalf of the purchaser before the cranes are put under operation immediately after the cranes are commissioned. The crane after erection will be tested as follows:

- i. Insulation tests and other tests mentioned will be carried out as per the latest edition of IS: 3177 (as applicable).
- ii. Deflection Test
The deflection test of the bridge girders will be carried out as per latest edition of IS: 3177. After the deflection test with safe working load, there will not be any permanent set after the removal of the load.
- iii. Speed Tests
 - All motion of the crane will be tested with rated load on all notches at the time of commissioning of the crane at site and the speeds will be attained within the tolerance limit.
 - All motions of the crane will be tested with 25% over load in which case the specified speeds need not be attained but the crane will show itself capable of dealing with the over load without difficulty.
 - Note for point ii and iii above:
Necessary test loads for testing at both shop floor and site will be arranged by Contractor / sub-contractor.
- iv. Brake Tests
 - The hoist brakes will be capable of braking the movement with rated as well as over load. (150% for hoisting and 125% for traveling. However, the braking path with rated load will not exceed hoisting speed/ 150 for class 1 & 2 duty cranes, speed/ 120 for class 3 duty cranes, speed/100 for class 4 duty cranes.
 - The long travel and cross travel brakes will be capable of arresting the motion within a distance in meters equal to 10% of the speed in meter / min and the retardation due to braking will not exceed the values as given in the table below :

Working condition of the crane	Retardation, according to percentage number of driving wheels, in m/sec ²		
	100	50	25
Indoor (When $\mu = 0.2$)	1.5	0.75	0.40

Legend μ = Friction Factor

11.7. PERFORMANCE GUARANTEE OF EOT CRANE

- a) After erection and commissioning of equipment, performance tests will be carried out to prove the performance of the system and equipment.



- b) These tests will be binding on both the parties of the contract determine compliance of the equipment /system with the performance guarantee.
- c) All the equipment, tools and tackles and consumables like oil, grease required for successful completion of the performance tests will be supplied by the successful Contractor.
- d) All the instruments for the performance tests, as required, will be supplied by the successful Contractor and will retained by him till the satisfactory conclusion of all tests at site. All costs associated with the supply, calibration, installation and return of test equipment will be included in the scope of supply. All test instruments will be as per standards approved by the Purchaser.
- e) If the successful Contractor fails to achieve the guarantee and performance parameters, he will investigate the causes and will rectify and/or replace, free of cost to the Purchaser the defects of the equipment/system within a period of 1 (one) month from the date of commencement of performance and guarantee tests and again prove the guarantees. In such cases, the cost of modifications including labour, materials, and cost of additional testing etc. will be borne by successful Contractor.
- f) If even after necessary alteration and modifications are affected, the performance guarantees are not fulfilled, the Purchaser reserves the right to reject the equipment. In the event of exercising this right, the successful Contractor will replace the defective equipment/ system with the equipment / system that meets the performance guarantee parameters. The cost of replacement inclusive of labour, materials and repeat testing to prove compliance with the performance guarantees will be borne by the successful Contractor. No time extension will be given for this type of replacement of equipment/ components
- g) The following basic performance parameter tests will be concluded:
 - All equipment will operate at rated capacity without undue vibration and undue noise etc.
 - Measurement of noise and vibration levels as per relevant IS
 - Measurement of power consumption of various drive motors while operating at performance guarantee levels.
 - Continuous run system performance test.
 - All other parameters of the equipment or system indicated in Inspection and Testing section abide.

11.8. SPECIAL CLEANING, PROTECTION AND PAINTING OF EOT CRANE

The exposed surface of all items of equipment will be thoroughly cleaned and painted. Refer chapter on painting in this volume.

11.9. DRAWINGS, CURVES AND INFORMATION REQUIRED DURING DETAIL ENGINEERING OF EOT CRANE

Besides submitting the enclosed form sheets and schedules after filling in, the proposal will also include the following information:

- a) Crane clearance diagram filling in the various dimensions.
- b) General Arrangement Drawings of the E.O.T. crane assembly.
- c) Detail drawing showing the features of the components of the crane bridge and trolley.
- d) Drawings and data on the crane runway rail, and its method of attachment to runway main girder and general arrangement of runway rail end stops.





- e) Schematic drawings of hoisting mechanism, cross travel mechanism and long travel mechanism indicating all components as well as rope receiving arrangement and relative positions of equalizer sheaves.
- f) A detailed write-up on the crane control system. Drawings and data sheets showing the particulars of the controllers, switches, contactors, relays, other control devices and limit switches will be provided.
- g) A comprehensive write-up and/or Brochure on the details of the manufacturing facilities and the test facilities in the shop of the supplier will be provided.
- h) Other relevant data and particulars.
- i) Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and materials of construction for —
 - EOT Crane Unit
 - Bridge Assembly and Components
 - Bridge End Trucks and Wheel Assembly
 - Trolley
 - Trolley Wheel Assembly
 - Drive and Transmission Unit for Bridge Travel, Trolley Travel, Main Hoist
 - Suspension Unit for Main Hook Block

FOR ELECTRICALLY TRAVELLING OVERHEAD CRANE

GUARANTEED PERFORMANCE REQUIRED (FOR EACH CRANE)

Deflection of main girder : Max. of 1/900 of crane span with SWL

DESIGN AND CONSTRUCTION

Duty class: Mechanism class : M5 as per IS-3177

Electrical service class : S4

Design ambient temperature for Motors : 50 Deg C

No. of starts per hour : 150

No. of Trolleys : One

Runway conductors - : PVC shrouded bus bar

a. Material :

b. Maximum allowable current density : 0.35 amps/sq.mm
at 40 deg. Ambient (suitable derating factor will be considered for design ambient condition)

INSPECTION AND TESTING

Deflection test at manufacturer's works : required

Radiography of structural welds in tension : required

Material testing and identification by : Manufacturer/Employer



Acceptance standard : IS-3177
Gear box assembly, hook test, wire : Certificate from the manufacturer
rope test, routine test of electrical
items

11.10. SINGLE GIRDER UNDERSLUNG CRANE (EOT/HOT)

11.11.1. SCOPE OF WORK

- a. The scope of work of the Contractor will consist of design, manufacture, inspection, assembly, painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of Hand- Operated/ Electrically operated Travelling U/S Crane with traveling Chain Pulley Block (CPB) as per technical parameters indicated in this specification.
- b. The scope of work of the Contractor will also include the following:
- c. Supply of initial requirements of consumables including replenishment during erection, testing & commissioning of the equipment.
- d. Supply of all and any spares to be needed for successful commissioning of EOT / HOT U/S crane.

11.11.2. TECHNICAL SPECIFICATION

- a. Codes and standards:
The design, manufacture and performance of EOT/HOT U/S crane along with manual hoist and Geared trolley will comply with all currently applicable status, regulations and safety codes and will also confirm to the latest applicable Indian or International standards.
- b. The crane structures will be designed Manufactured and tested in accordance with IS: 807-2006. The Crane will be designed with a margin of 25%.
 - Black bolts will not be used in the load bearing structures of the crane. Also high tensile friction grip bolts will not be used unless approved by purchaser.
 - Traverse fillet welding on the load carrying members will be avoided.
 - All butt welds on the structural members, subject to tensile stress, will be X-rayed.
 - Maximum deflection of the bridge girder of U/S crane with safe working load on the travelling hoist will not exceed 1/900 of the span of crane with travelling hoist stationed at mid span and excluding deflection due to dead load.
 - U/S crane will be supplied complete with buffer & buffer stops.
 - The u/s crane after installation at site will be load tested as per IS: 807-2006.
- c. Technical specification of Manual Hoists & Geared Trolleys to be used in HOT U/S crane
 - Ball and roller anti frictional bearing only will be used.
Swiveling type standard shank hook mounted on grease lubricated anti-friction thrust bearing will be used.
The Chain Pulley Block will conform to class-I duty as per IS: 3832-2005.
 - Load chain & operating chain will be of calibrated type.
 - Pulley used for the operating mechanism will have suitable guards to prevent the operating chain from coming out.
 - All the open gearings will have suitable cover.
 - No-load testing will be done at works after full assembly in presence of purchaser.
The Chain Pulley Block will be load tested at site after erection.
 - No wooden parts will be used in the Chain Pulley Block.





- Travelling speeds, tractive effort & bill of materials will be indicated by the Contractor during approval of drawing & will be subjected to purchaser's approval.

11.11.3. PAINTING

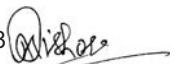
The exposed surface of all items of equipment will be thoroughly cleaned and painted. Refer: chapter on painting in Volume - IIA.

11.11.4. INSPECTION AND TESTING

The manufacturer will conduct all tests required to ensure that the equipment furnished will conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS: 3832-2005 or equal standards for HOT cranes and IS:3177 for EOT cranes

11.11.5. PERFORMANCE & GUARANTEE

After erection and commissioning of equipment, tests will be carried out to prove the performance of the system and equipment.





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SECTION-9,
MOTORS



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Prakash



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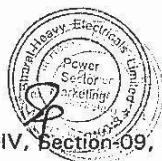
1 GENERAL

This specification is intended to cover the design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site and delivery of Electric Motor complete with all accessories for efficient and trouble-free operation of 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

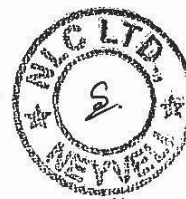
2 CODES & STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

- IEC: 60034-1 : Rotating electrical machines.
- NEMA, MG-1 : Motors and Generators
- ISO : 1940-1 : Mechanical vibration – Determination of permissible residual unbalance
- IS : 325 : Specification for three phase induction motor.
- IS : 900 : Code of Practice for installation and maintenance of induction motors
- IS : 996 : Single phase AC motors
- IS : 1231 : Dimensions of three-phase foot-mounted induction motors
- IS : 1271 : Thermal evaluation and classification of electrical insulation.
- IS : 2223 : Dimensions of flange mounted ac induction motors.



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IS : 2254	: Dimensions of vertical shaft motors for pumps
IS : 3043	: Code of practice for earthing.
IS : 3177	: Crane duty motors
IS : 4029	: Guide for testing three phase induction motors.
IS : 4691	: Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	: Specification for rotating electrical machinery.
IS : 4728	: Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	: Methods of determination of efficiency of rotating electrical machines.
IS : 5571	: Guide for selection of electrical equipment for hazardous areas.
IS : 6362	: Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	: Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	: Values of performance characteristics for



three phase induction motors.

- IS : 12065 : Noise level of motors.
- IS : 12075 : Measurement and evaluation of vibration of rotating electrical machines.
- IS : 12615 : Induction motors - Energy efficient, three-phase, squirrel cage - Specification
- IS : 12802 : Temperature rise measurement of rotating electrical machines
- IS : 12824 : Type of duty and classes of rating assigned.
- IS : 14222 : Requirements and method of Impulse withstand test
- DIN/IEC/IS : RTD
- BS 5308 part II : RTD triad Cable

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted will be submitted along with the bid.

The electrical installation will meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work will be followed.

3 DESIGN CRITERIA

All motors will be suitable for an ambient temperature of 50 degree C and relative humidity of 85%. The motors will be suitable for operation in a highly polluted environment.

AC Motors will be of constant speed, squirrel cage, three/ single phase, induction type. Motors will be rated for continuous duty. They will also be suitable for long period of inactivity.





DC motors provided for emergency service will be shunt / compound wound type. Motor will be sized for operation with fixed resistance starter for maximum reliability.

Power supply for AC motors will be as follows:

- Below 0.22 kW : 240V, 1 Phase, 50Hz
- From 0.22 kW upto & including 160 kW : 415V, 3 Phase, 50Hz
- Above 160 kW upto & including 750 kW : 3.3kV, 3 Phase, 50Hz
- Above 750 kW : 11KV, 3 Phase, 50Hz

All AC motors will be suitable for following voltage & frequency variations as follows:

- Voltage Variation : (±) 10%
- Frequency Variation : (+) 3% to (-)5%
- Combined Variation of Voltage & Frequency : 10% (absolute sum)

Frequency

The motor characteristics will match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

Moreover, motors will be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

For 11kV motors, locked rotor current not to exceed 600% of full load including positive tolerance except BFP & CWP. (For BFP & CWP the starting current will be 450% of FLC). For 3.3 kV and 415 V motors Locked rotor current not to exceed 600% of full load with IS/IEC tolerance.

Maximum continuous motor ratings will be at least 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

Accelerating torque at any speed with the lowest permissible starting voltage will be at least 10% motor full load torque.



The motors will be suitable for bus transfer schemes provided on the 11KV, 3.3kV and 415V systems without any injurious effect on its life. If motors are connected to an automatic bus transfer system, they may be subjected to 150% of the nominal voltage during changeover of buses due to the phase difference between the incoming voltage and motor residual voltage. In such cases, Motors will be capable of restarting under full load after momentary loss of voltage.

Motors will be of energy efficient of type Eff-2 as per IS: 12615/equivalent IEC/ International Standards.

Motor will be designed to keep torsional and rotational natural frequencies of Vibration of the motor and driven equipment atleast 25% above the motor operating speed range.

System Grounding

- | | | | |
|-----|----------------|---|--|
| (a) | 11 kV , 3.3 kV | : | Low Resistance Grounded to limit the earth fault current to 300 Amps |
| (b) | 415 V | : | Solidly Grounded |
| (c) | 220V DC | : | Ungrounded |

Fault Level

- | | | | |
|-----|----------------|---|--------------------|
| (a) | 11 kV , 3.3 kV | : | 40 kA for 1 second |
| (b) | 415 V | : | 50 kA for 1 second |
| (c) | 220V DC | : | 15 kA for 1 second |

Degree of Protection

- | | | | |
|-----|-----------------------------------|---|-------|
| (a) | Indoor Motors | : | IP 54 |
| (b) | Outdoor Motors | : | IP 55 |
| (c) | Cable Box located in Indoor Area | : | IP 54 |
| (d) | Cable Box located in Outdoor Area | : | IP 55 |

Winding Insulation

- | | | | |
|-----|----------------------------|---|-----------|
| (a) | For 11 kV/3.3 kV AC Motors | : | Class - F |
|-----|----------------------------|---|-----------|



(b) For 415V AC Motors : Class - F

(c) For 220V DC Motors : Class - F

Winding Conductor Material

(a) For 11 kV/3.3 kV AC Motors : Copper

(b) For 415V AC Motors : Copper

(c) For 220V DC Motors : Copper

Bearing

(a) For Drive End : Roller

(b) For Non Drive End : Roller / Ball

Temperature Rise

(a) For Air Cooled Motors : 70 °C over ambient temperature

(b) For Water Cooled Motors : 80 °C over inlet cooling water temperature

Motor Earthing

(a) Motors above 90 kW : 50 x 6 mm GI Flat

(b) Motors above 30 kW and upto 90 kW : 25 x 6 mm GI Flat

(c) Motors above 5 kW and upto 30 kW : 25 x 3 mm GI Flat

(d) Motors upto 5 kW : 8 SWG GI Wire

(e) Terminal Box : 8 SWG GI Wire

Space Heater



- (a) For Motors and above 30 : Space heater suitable for 1Phase,
kW rating 240V AC, 50 Hz supply
- (b) For Motors below 30 kW : No Space heater provided.
rating

Painting

- (a) Paint Type : Epoxy based with approved class
- (b) Paint Thickness : Within 100 to 150 micron.

4 SPECIFIC REQUIREMENTS

4.1 Locked Rotor Withstand Time

HT Motor

- The locked rotor withstand time for HT motors under hot conditions at 110% rated voltage will be more than the starting time at minimum permissible voltage by at least three seconds or 15% of the accelerating time whichever is greater.
- Provision of speed switches will be avoided to the extent possible. In case speed switch is required to mount on the motor shaft, the same will remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch will be capable of withstanding 120% over speed in either direction of rotation.

LT Motor

- The starting time of the motor will be at the minimum permissible voltage.
- For motors with starting time upto 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be at least 2.5 second more than starting time.
- For motors with starting time more than 20 second and upto 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be at least 5 second more than starting time.
- For motors with starting time more than 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit will be more than starting time by at least 10% of the starting time.
- Speed switches mounted on the motor shaft will be provided in cases where above requirements are not met.



4.2 Starting Voltage Requirement

- (a) 85% upto 1500 kW
- (b) 80% for above 1500 kW upto 4000 kW
- (c) 75% > 4000 kW

Motor will be designed for direct on line starting at full voltage. Starting current will not exceed 6 times full load current (subject to IS tolerance) for all auxiliaries.

The motor will be capable of withstanding the stresses imposed if started at 110% rated voltage.

H.T Motor will start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except for mill motors for which 90% RV will be the minimum starting voltage. L.T Motor will start with rated load and accelerate to full speed with 85% rated voltage at motor terminals.

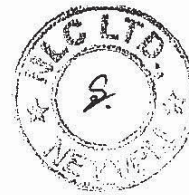
Pump motor subject to reverse rotation will be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

The motor will be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

4.3 Winding and Insulation

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) 11 kV and : Winding material will be of copper. Insulation will be
3.3 kV AC of Class F with winding temperature rise limited to
motors Class B. They will withstand 1.2/50 microsecond
switching surges of "4U+5 KV" (U=Line voltage in
KV). The coil inter-turn insulation will be suitable
for 0.3/3 micro second surge of 32 / 12 KV
followed by 1 min power frequency high voltage





test of appropriate voltage on inter turn insulation.

- (c) 415V AC & : Winding material will be of copper. Insulation will be
220V DC of Class F with temperature rise limited to Class B.
motors
- (d) Conveyor Short circuit rings of conveyor motors will be either
motors joint less or welded type. Brazed joint is not
acceptable.

4.4 Motor Control

(a) For HT Motors

- Motors of rating above 160 kW and up to 750 KW will be suitable for 3.3 KV voltage
- Motors above 750 KW will be suitable for 11 KV voltage.
- Frequent starting motors of rating above 160 kW to 750 kW will be suitable to be controlled by vacuum contactors

(b) For LT Motors

- Motors of rating less than 90 kW will be operated by Contactor Electronic overload relays etc. from respective MCCs.
- Motors of rating up to 18.5 KW will be provided with MPCBs.
- Motors of rating above 18.5 KW and below 45 KW will be provided with MCCBs.
- Motors of rating 45 KW and above but less than 90 KW will be provided with MCCBs with CT operated Electronic over load relays .
- Motors of rating 90 KW and up to 160 KW will be suitable to be



controlled by Air circuit breakers from PCC, PMCCs, and will be provided with comprehensive numerical motor protection relays.

4.5 Starting duty

Motors will be suitable for 3 nos. consecutive Cold starts up and 2 nos. consecutive Hot starts up. Motors will be suitable for three equally spread starts per hour when the motor is under normal service condition. However in case of multiple start motors like conveyor motors three starts will be allowable from hot condition with maximum 20 starts per day and minimum 20,000 starts during life time of motor.

4.6 Bearings

- Anti-friction type radial and thrust bearings (ball, roller) and sleeve bearing will be rated for minimum standard life of 40,000 hours taking bearing and driven equipment loads (in case the drive is not having separate thrust bearing) into account. If bearings are lubricated, loss of grease will be scarce and it will not creep along shaft into motor housing. Facility of removal of excess grease will also be provided for grease lubricated bearings.
- Vertical shaft motors will be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if Anti-friction bearings can take vertical thrust, thrust & guide bearings are not required.
- Bearing will be effectively sealed against dust ingress and will be pressure grease gun lubricated. The bearing and housing will be so designed that greasing will be possible while the motor is running, without removal of covers.
- Where bearing supports are attached to the motor casing, adequate bracing will be provided on these supports to reduce vibrations and ensure life of bearings.
- If the bearings are oil lubricated, a drain plug will be provided for draining residual oil and oil level gauge will be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system will be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- Lubricants will be selected for prolonged storage and normal use of motors in tropical climate and will contain corrosion and oxidation inhibitors. Greases will have suitable bleeding characteristics to minimize setting. The selected lubricants will be indigenously available.
- Motors rated above 1000 kW will have insulated bearings to prevent flow of shaft currents.

4.7 Temperature Rise

- For Air Cooled Motors, temperature rise of insulation should be limited to 70 Deg C over ambient temperature by resistance method.



- For Water Cooled Motors, temperature rise of insulation should be limited to 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method.

4.8 Cooling

All motors will be either Totally Enclosed Fan Cooled (TEFC) or Totally Enclosed Tube Ventilated (TETV) or Closed Air Circuit Air Cooled (CACA) type. However, motors rated 3000 kW or above can be Closed Air Circuit Water Cooled (CACW).

4.9 Enclosure

- All motor enclosures will conform to the degree of protection of IP54 for indoor and IP-55 for outdoor installation unless other wise specified. Motor for outdoor or semi outdoor service will be of weather proof construction. Motors of large output rating located indoor could have screen protected drip proof (SPDP) enclosure conforming to IP-23.
- For motors located in outdoor & corrosive locations, FRP canopy will be provided. In case steel canopy is provided, the same will be epoxy painted to meet the surrounding atmosphere. Motors located in hazardous areas will have flame proof enclosures conforming to IS: 2148 as detailed below:

- Fuel oil area : Group – IIB

4.10 Noise Level and Vibration

- Noise level will be limited to 85 dB (A) at 1.5 meters from the motor. However the same will be as per IS: 12065 unless otherwise specified. The peak amplitude of vibration will be within the specified limits laid down in IS: 12075. Motors will withstand vibrations produced by driven equipment. HT motor bearing housings will have flats in both X and Y directions suitable for mounting 80mmX80mm vibration pads. Vibration pads with screwed holes for mounting vibration probes will be provided along with motors at both DE and NDE.

4.11 Temperature Monitoring

In HT motors, atleast four numbers simplex/ two numbers duplex platinum resistance type temperature detectors will be provided for each phase of stator winding. Each bearing will be provided with dial type thermometer with adjustable alarm contact and two numbers duplex Platinum resistance type temperature detector (3 wire 100ohm at zero deg C). In case of CACA and CACW motors dial type temperature indicator will be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). If alarm and trip





are required for cooling air temperature, temperature switch will be provided. The contact rating will be minimum 0.5A at 220V DC and 5A at 240V AC. Flow switches will be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing. The contact rating will be minimum 0.5A at 220V DC and 5A at 240V AC.

4.12 Earthing

Motor body will have two earthing points on opposite sides. Motor terminal boxes will also have separate grounding terminals.

4.13 Termination

- HT motors can be offered with either Elastimold termination or dust tight phase segregated double walled (metallic as well as with insulated barrier) cable boxes. In case Elastimold terminations are offered, then protective cover and trifurcating sleeves will also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) will be provided in case of cable boxes. The main cable box / terminal box will withstand a fault current upto 40 kA for 0.25 seconds for MV motors and 50 kA for 0.25 seconds for LV motors. Separate terminal boxes will be provided for space heaters and RTDs.
- Terminal box shall be capable of being turned through 360 degrees in step of 90 degrees. However in case of rectangular type, terminal box will be rotatable in steps of 180 degree.
- For HT motors the distance between gland plate and the terminal studs will not be less than 500 mm.
- Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed will be as follows:

Table 4.1

Minimum inter-phase & Phase earth air Clearances

S.No	Motor MCR in kW	Clearance, in mm
1	Up to 110kW	10
2	Above 110 and Up to 150kW	12.5
3	Above 150kW	19

4.14 Differential Protection

- For motors rated 11kV, 1000 KW & above, neutral current transformers of PS class will be provided on each phase in a separate neutral terminal box for differential protection.



4.15 Tropical Protection

- All motors will have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- All fittings and hardwares will be corrosion resistant.
- Space Heater
- Suitable single phase space heaters operated at 240V, 50Hz, 1Phase AC supply will be provided on motors rated for 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs will be provided.
- The space heater will be sized to maintain the motor internal temperature above dew point when the motor is in idle condition.
- For motor below 30KW, the motor winding will be suitable for continuous heating.

4.16 Rating Plate

Motor will have Stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / NEMA-MG-1 and following additional information:

- a) Type of bearing and recommended lubricants along with location of insulated bearing.
- b) Temperature rise under normal/abnormal conditions.
- c) In addition to above, an arrow block will be screwed on to the body of motor on the non-driving end to indicate normal direction of rotation of motor.
- d) Year of Manufacture

4.17 Drain Plug

Motor will have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

4.18 Dowel Pins

Motor will be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

4.19 Painting

The complete motor assembly including fan will be painted with corrosion proof paints of approved class.

4.20 Lifting provision

Motor weighing 25 Kg or more will be provided with eyebolt or other adequate provision of lifting.

5 TESTS

5.1 HT Motors

5.1.1 Routine Test



All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

5.1.2 Type Test

For each type & rating of HT motors the Contractor will submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor will conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

5.2 LT Motors

5.2.1 Routine Test

All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IS/IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

5.2.2 Type Test

LT motors will be of type tested quality. For each type & rating of LT motors rated above 50 KW, the Contractor will submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor will conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

5.3 Test Witness

The tests will be carried out in presence of the Owner's representative, for which a minimum 7 days notice will be given by the Contractor. The Contractor will obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure will clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

5.4 Test Certificates

- Certified copies of all tests carried out at works and at site will be furnished in requisite no. of copies for approval of the Owner.



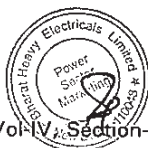
- The equipment will be dispatched from works only after receipt of Owner's written approval of shop test reports.

6 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors will be submitted as indicated below:

Dimensional General Arrangement drawing

- Motor sizing calculation
- Foundation Plan & Loading
- Cable end box details
- Space requirement for rotor removal
- Thermal withstand curves hot & cold
- Starting and speed torque characteristics at 80% & 100% voltage
- Complete motor data
- Erection & Maintenance Manual
- Test reports
- QAP



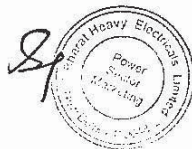
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SECTION-16
LV POWER & CONTROL CABLE



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1 GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport to site of LT Power & Control Cable complete with all accessories for efficient and trouble-free operation for 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2 CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below or any international standard acceptable to purchaser.

IS:1554(Part I) : PVC insulated(heavy duty) electric cables for working voltage up to and including 1100V

IS:1554(Part II) : PVC insulated(heavy duty) electric cables for working voltage from 3.3kv up to and including 11Kv

IS: 3961 : Recommended current ratings for cables.

IS: 8130 : Conductors for insulated electric cables and flexible cords

IS:5831 : PVC insulation and sheath of electric cables

IS: 2982 : Copper conductor in insulated cables and cords.

IS: 3975 : Mild steel wires, strips and tapes for armouring cables

IS: 5609 : Specification for low frequency wirers and cables with PVC insulation and PVC sheath

IS: 6380 : Specification of elastomeric insulation of sheath of electric cables.

IS: 434(I and II) : Specification for rubber insulation cables.

II)



IEC: 540	: The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC: 230	: Impulse tests on cables and their accessories
IEC: 60	: High voltage test techniques
IEC: 287	: Calculation of the continuous current rating of the cables(100% load factor).
IEC: 288	: Nominal cross sectional area and composition of conductor of insulated cables.
IEC: 502	: Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
NEMA-WC-5	: Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
IEEE: 383	: Standard for type test for class IE electric cables, filled splices and connection for nuclear power generation station.
IEC: 332-1	: Test on electric cables under fire conditions.
ASTM-D-2843	: Standard test method for density of smoke from burning/decomposition of plastics.
ASTM-D-2863	: Test for determination of oxygen index.
IEC-754-I	: Test method for acid gas generation
IEC-331	: Fire resisting characteristics of electric cables



SVENSK Standard SS-4241475 Class F3

- BICC Hand Book For cables in fire regarding temperature index-chapter-6
- Indian Electricity Rule.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted will have to be submitted along with the bid.

The electrical installation will meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work will be followed.

3 DESIGN CRITERIA

The cable will be used for connection of power and control circuits of the auxiliary electrical systems.

The cable will be suitable for installation in the required site conditions.

Cables will be sized suitably with proper derating factors as per the installation conditions of the cable.

For continuous operation at specified rating as well as during short circuit condition the maximum conductor temperature will be limited to the permissible value as per relevant standard.

The insulation and sheath materials will be resistant to oil, acid and alkali and will be tough enough to withstand mechanical stresses during handling.

Armouring, wherever provided, will be single round/ flat wire of galvanised steel for multi-core cables and aluminium for single core cable. Cables in buried formation will be armored. Cables laid in duct banks/conduits will be unarmoured.

The outer sheath as well as the inner sheath will have flame retardant low smoke (FRLS) characteristics and will meet the requirements of additional tests specified for this purpose.

Core identification for multi-core cable will be provided by colour coding.

Power cables will be chosen taking into account the following factors:

- a) System Fault level.
- b) Maximum time for fault clearance (i.e, operating time of the back up protection relays plus the time of operation of the circuit breakers).
- c) Full load current of the circuit.
- d) Short circuit current and duration 0.2 sec (for breaker protected cables)
- e) Installation conditions.
- f) Voltage drop under normal running and starting condition
- g) Voltage drop at motor terminals will be within permissible limit during starting & normal running.



- h) The cable should withstand the maximum fault current corresponding to the particular voltage level for the minimum time before the fault is cleared.
- i) Consideration will also be given to limit the cable to the nearest standard sizes instead of using too many types.
- j) The standard cable sizes, ampacities, derating factors, etc. will be as given in IS or relevant standard.
- k) The minimum size of power cables to be used will be as follow :
 - Aluminium conductor : 6 Sq. mm.
 - Copper conductor : 2.5 Sq. mm.

4 SPECIFIC REQUIREMENTS

4.1 Type of Cable

LV power cables will be stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC sheathed cables conforming to IS : 7098.

Control Cables will be 1100 V grade with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed cables conforming to IS : 1554.

4.2 Conductor

The cable conductor will be made from standard Aluminum for LT Power cables and Copper for control cables to form compact conductor having a resistance within the limits specified. All the cables of size 25mm² and above will have sector shaped conductors.

4.3 Insulation

The insulation of the LV power cable will be XLPE type & for control the insulation will be PVC type. It will be designed and manufactured for the specified system voltage. The manufacturing process will ensure that insulation will be free from voids. The insulation will withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give a very smooth interface between semi conducting screen and insulation. The insulation of the cables will be of high standard quality.

4.4 Inner Sheath

The sheath will be suitable to withstand the site conditions and the desired temperature. It will be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from all defects. PVC sheath will be extruded.

4.5 Armour

Hard drawn aluminum wire armouring/ galvanized steel tape/ wire armouring will be used for single core and multi-core cable respectively. Cables should be un-armoured wherever indicated. The hard drawn aluminium wire for armour will be of H4 grade, as per IS-8130 (having tensile strength above 150 N/mm²). The